HORSELESS AGE The oldest automotive paper published in the English language has been purchased by The Class Journal Co. Its engineering features, and a part of its circulation, have been merged with AUTOMOTIVE INDUSTRIES

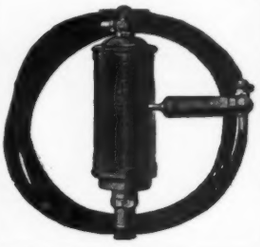
AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Vol. XXXIX
Number 22

PUBLISHED WEEKLY AT 239 WEST 39th STREET
NEW YORK, NOVEMBER 28, 1918

Fifteen cents a copy
Three dollars a year

Entered as second-class matter Jan. 5, 1903, at the post-office at New York, N. Y., under the Act of March 3, 1879.



UTILITY PUMPS
for All Cars $12.00.
For Fords $7.50

UTILITY HEATERS
for All Cars $9.00 to $25.00

What Heater?

Car heaters are here to stay. No one will deny that. They are fast modernizing every car. The only question is what heater to sell —what heater to install.

Dealers and car users who know most about heaters favor the UTILITY. There are many reasons.

UTILITY Heaters cost nothing to operate—have no upkeep expense—heat, but cannot burn —can be regulated to any degree of temperature—collect no dirt—are installed without ruining the floor board—furnish a neat ornamental foot-rail—cost little for great comfort.

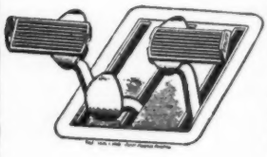
There is a UTILITY Heater for every car, ranging in price from $9.00 to $25.00. Handled by good dealers everywhere. Send for booklet.

Dealers: Order of your jobber.

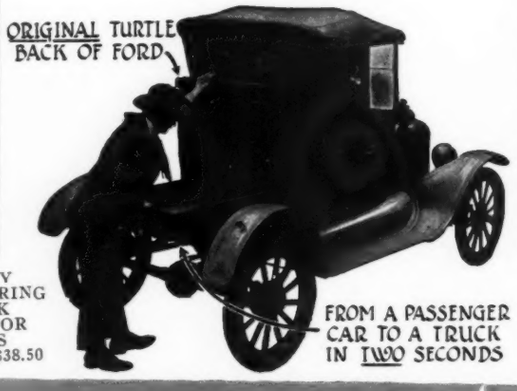
UTILITY RIM
WRENCH
for All Cars $1.75

HILL PUMP VALVE CO.
Mfrs. of UTILITY Products
Archer Ave. and Canal St. Chicago
Sales Department
THE ZINKE CO., 1323 S. Michigan Ave., Chicago

UTILITY PEDALS
For Fords $1.25



UTILITY UNIVERSAL
WRENCH
Set for All Cars $3.50



UTILITY
DISAPPEARING
TRUCK
BODY FOR
FORDS
Price $38.50

UTILITY
Automotive Products

AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

VOL. XXXIX NEW YORK, THURSDAY, NOVEMBER 28, 1918—CHICAGO No. 22

Probable Effects of War Motor Apparatus on Commercial Design

Solution of Many Problems Connected with the Development of Creeper Type Machines Should Be Useful—War Experiences Likely to Benefit Engineering

WITH the war drawn to a close, it will be only a short time before a large number of officers who have served during the period of hostilities, in the non-combatant branches, will be released. In the Ordnance and Quartermaster departments there have been a large number of men recruited from the automobile and allied industries. These men are going to bring back into the industry the fruits of an experience which should be of material value in commercial life.

One of the results of our short period of war will be to reintroduce into the automotive industries a number of men who have gained an intensely valuable experience and, furthermore, it is going to be possible to adapt for commercial uses some of the highly valuable apparatus developed for war purposes. There has been a wide variety of new material designed for extremely rigorous usage, and since this material was planned without regard to experimental cost it is in the main the acme of useful design.

Lessons from the Ordnance Department

It is not necessary to search further than the Motor Equipment Section of the Engineering Division, Army Ordnance, for a record of engineering accomplishment from an automotive standpoint. In fact, the work done during the past year in this section has never been duplicated in commercial life. With appropriations amounting to hundreds of millions, and the resources of the country both in raw materials and manufacturing facilities at its disposal, this department has gone ahead on a program which has already placed this country at the head of the list in certain forms of motor equipment.

The work covered by this section has been of wide scope. It has embraced everything from heavy fighting tanks to motorcycles. It has included every sort of drive, including all forms of track-laying types as well as solid and pneumatic tired wheel variety. Out of this wealth of apparatus it is certain that we can derive some valuable lessons for commercial usage. Driven by military necessity, the Motor Equipment Section has designed special types of bodies adaptable to a wide line of truck chassis which show a marked ingenuity and utility and which immediately suggest the possibility of well-planned special body designs for industrial and merchandising requirements.

Some Examples of Special Design

It may be interesting to cite a few typical instances of special design which are not surrounded by a veil of secrecy. Probably of greatest use from a military standpoint, and perhaps adaptable to a field not fully realized in agricultural and other peaceful pursuits, are the heavy type of track-laying tractors.

The heaviest of these brought out by the Ordnance Department is the 20-ton artillery tractor, which is a specially adapted 120-hp. Holt design. It is 252 in. in length and weighs 27,000 lb. with gasoline, oil

and water. Yet its ground pressure is only 7.17 lb. per square inch.

This tractor is particularly designed for hauling heavy guns and other weighty military material over all sorts of road and ground conditions. Its low unit pressure and high drawbar horsepower enable it to bring the heaviest pieces of artillery into action regardless of highly difficult conditions of terrain.

The 10-ton artillery tractor is a similar design with many of the same characteristics, though, of course, due to its lighter weight it has a higher speed capacity. The 20-ton pulls its load at 3.27 m.p.h. at 600 r.p.m., while the 10-ton pulls its load at 4.19 m.p.h. at 600 r.p.m., or at 5.59 m.p.h. at 800 r.p.m. There are also 5-ton and 2½-ton artillery tractors which travel at correspondingly higher speeds.

At first it would not seem probable that equipment of this kind would be readily adaptable to agricultural, commercial or merchandising purposes, yet there are many sections of the country where devices of this kind would be highly useful in logging, hauling and farming operations.

Heavy Haulage Problems Attacked

There are many sections of the country undeveloped because of the difficulty of hauling heavy loads over the soft and marshy ground. It has always been true in this country that after a war considerable employment has been found for returned soldiers in the development of tracts of previously unimproved territory. The apparatus which has proven so valuable in war work over ground torn by shell fire cannot help but be of assistance in work of this nature.

The utilization of knowledge gained in special truck designs is certain to be a stimulation in the truck field. The success of the war designs, in which the co-operative efforts of various engineers in the truck industry were utilized to produce the best possible truck regardless of expense, has taught lessons which have already begun to make themselves felt.

While quite certain that the question of economy was the last considered in the war designs, and endurance and performance given the first consideration, it will not be necessary to discard all that has been learned in these designs to produce successful commercial vehicles.

Work of Civilian Employees

The work of the Motor Equipment Section in regard to its line of trucks and truck bodies has been one of the bright spots in this country's rapid preparation for war. It is needless to say that the majority of the accomplishments in this field were made by men drawn from the automotive industries. In Washington in military and civilian capacities are men who are working at one-tenth their previous incomes in many cases. These men have gone wholeheartedly about supplying a line of motor equipment which has increased the mobility of our army equipment to a vast extent.

These trucks are of all sizes, some of them, such as the F. W. D., Nash, White, Commerce and Dodge, have been taken almost entirely from commercial production, and with only slight engineering modifications have been made to fulfill a wide line of purposes. On these chassis have been mounted bodies adapted for carrying supplies, men and traveling repairshops which have been invaluable in maintaining the artillery and equipment of the armies in the field.

A great many of the ordnance vehicles have been mounted on the Nash 2-ton and the F. W. D. 3-ton truck chassis, and certain bodies have been mounted on both these chassis. From truck chassis like the 1-ton White, high-speed truck service has been required.

Forecast of Vehicles to Come

For example, on this chassis has been mounted a staff observation car having a rated load capacity of 1 ton. This is a pneumatic tired job capable of carrying nine passengers. The front and rear seats comfortably seat three persons each and the folding auxiliary seats accommodate three more. The chassis is of White manufacture, conventional in design and has a rated capacity of 1 ton. The tires are 36 x 6 in. and the car is driven by a four-cylinder block cast White engine.

The car carries a complete set of mechanic's hand tools and body equipment tools, the latter consisting of shovels, pick, lantern and so forth. The body is also fitted with numerous chests for special equipment. It is provided with a four-speed gearbox and throughout is designed for severe overland service.

Probably the lightest truck chassis utilized by the Motor Equipment Section has been the Dodge. The light repair truck body mounted on this is typical of the sort of load which this chassis is relied upon to carry. It has a rated load capacity of 1000 lb.; the maximum gross weight loaded is 3600 lb. The body on this is an Ordnance Department design, while the chassis is very little different from the passenger car chassis made by Dodge Brothers. The body is made up entirely of steel and is divided into a front compartment which has a single seat and a rear compartment which is used for trucking purposes, closed by a tail-gate or door.

The front seat can carry three. The rear part of the body has the following inside measurements: length from back of seat to the tail-gate or door, 62½ in.; inside width, 46 in.; height, 48 in. The body carries a complete repair equipment of machine and carpenter tools, a mechanic's vise which can be attached to the tail-gate and a 2-ton block and tackle. In addition there are chests in which repair parts and emergency lubricants are carried.

Adapting Commercial Designs

As an example of a body used on two chassis there is the machine gun car which is mounted on the 1-ton Commerce chassis and also the White chassis. This machine gun car is a standard design so arranged as to carry nine passengers, a machine gun, and various equipment such as spades,

(*Continued on page* 945)

Resistance of Hot Spark Plug Insulators

Tests Conducted to Determine the Loss of Resistance of Insulators at Spark Plug Working Temperatures—How Such Loss Affects the Action of the Plug

By Dr. R. H. Cunningham
Consulting Ignition Engineer

WITHIN the past 2 years considerable attention has been directed to the electrical behavior of certain insulating materials for spark plugs, and since the advent of the high-compression airplane engine with its plug-disturbing tendencies, both spark plug and engine manufacturers have had special reasons to urge the makers of such insulation to produce materials more suitable, both mechanically and electrically, to the requirements of internal combustion engines.

Although there is plenty of room for scientific criticism of the shapes, dimensions and design of some of the commercial spark plugs, both from a mechanical and an electrical standpoint, my aim in this article is only to discuss broadly the electrical behavior of some of the materials most commonly employed as insulators in spark plugs.

Heat Impairs Insulating Qualities

It has long been recognized that when insulators such as porcelain, mica, quartz, etc., are heated up they become conductive to a certain extent, so that if these substances are used for spark plug insulation, forming the dielectric of a condenser, more or less leakage of charge takes place and gives rise to misfiring.

This leakage of electric charge is made up of two components, namely, leakage over the surface of the insulator and leakage through its substance.

Although it is quite possible to separate these two leakages numerically when the insulating material is of a certain form, it is rather difficult to do so in the case of the usual spark plug, owing to the shape of the insulator and to the disposition of its various metallic parts. In certain types of porcelain plugs, however, a fair idea of the surface leakage, as differentiated from the substance leakage, can be obtained by the means described below.

Surface Leakage Must Be Considered

In giving data relating to the resistance of insulators of this kind, the customary method has been to state the resistance in ohms or meg-ohms between opposite faces of a cube of one centimeter length of side, and usually an alternating electric motive force of from 60 to 100 cycles and of approximate sine wave form is applied to the insulation under test. Although the meg-ohms of a centimeter cube are well enough to know from a scientific standpoint, such knowledge conveys very little definite information to the makers of spark plug insulation and to spark plug manufacturers. Besides, the results obtained by the application of the alternating sine wave current to the insulation give but a very hazy idea of what occurs when the insulation is assembled in the plug and a portion of the latter is subjected within the hot compression chamber to the "steep front," high voltage electric surges that are delivered by efficient types of ignition apparatus.

It occurred to the writer, therefore, over a year ago, that it would be both interesting and instructive to study the leakage behavior of several commercial varieties of spark plugs, both in the cold state and when heated to temperatures of 100° C. or higher, applying, however, potential differences to the plug electrodes more closely equalling those applied in actual service. It seemed quite reasonable to infer that with the information such an investigation would furnish, one should be able to predict the electrical behavior of plugs in an engine from preliminary measurements of a few sample plugs of similar design and of the same material. Thus, if much leakage of current occurs in the hot plug, one logically infers that there will be at least a serious diminution in the intensity of the high-tension ignition spark, especially when the generator of the spark is capable of but feeble output. Nevertheless, it is conceivable that even if certain kinds of hot spark plugs do leak to some extent, the effects of such leakage upon the maximum voltage usually created at the points of the plug by the high tension ignition magneto or induction coil may be partly compensated by both the increased ionization that occurs on heating the plug, and the increased conductivity of the heated, smoky, gaseous dielectric filling the space between the points just prior to the ignition of the compressed gas.

Maximum Temperature of Plug

During the consideration of the various methods whereby a solution of the above problem might be obtained, the first question that puzzled the writer was, "How hot does a spark plug become in a working combustion engine?" That part of the plug exposed to the surrounding air, and that part of the metal shell screwed into the usually water-jacketed cylinder, never become heated to the same extent as the portions of the plug within the cylinder. Now, although the plug points, and probably the tip end of the central stem of insulation undoubtedly do very often become red hot, at least

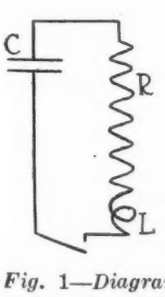


Fig. 1—Diagram of spark circuit

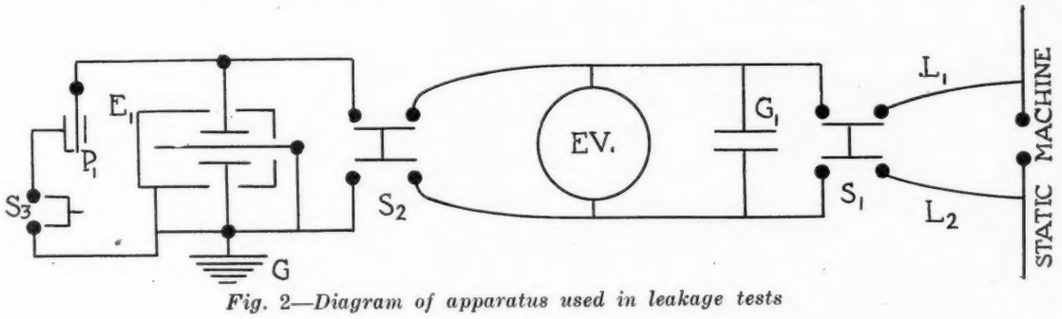


Fig. 2—Diagram of apparatus used in leakage tests

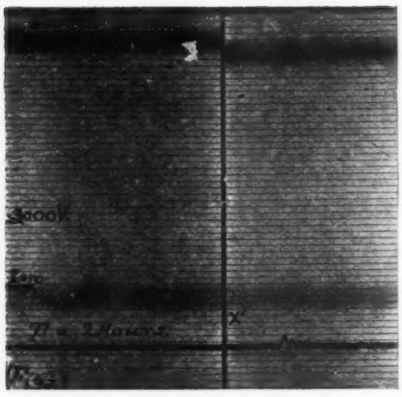


Fig. 3—Control curve of apparatus

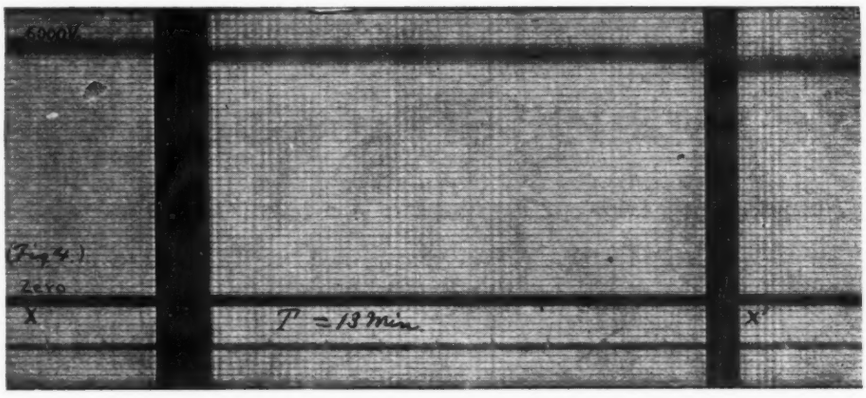


Fig. 4—Leakage curve of cold porcelain plug

for a brief period during the explosion stroke, very probably in a properly cooled engine the redness has disappeared from these parts early in the suction stroke, so that at the time of firing the compressed gas, the plug points and adjacent insulation, although quite hot, are no longer incandescent. Were this not the case, preignition from clean hot plugs would be quite the rule rather than the exception.

High Temperature Assumed

Since no definite information regarding the temperature reached by the plug in the average engine was obtainable, it was considered better to investigate the degree of leakage that is present in the plug when heated to a temperature somewhat higher than that reached by it in a working engine. If the plug still retained its sparking function under such conditions, the logical conclusion would be that, since the leakage increases with increase of temperature of the insulator, the plug would perform its function still better at lower temperatures. Although a number of plugs were investigated at temperatures varying from 23° C. to 360° C. the most striking results were obtained from those heated to a dull red heat usually, and in some instances to a cherry red (500° C. to 800° C.). Spark plugs are subjected to voltages of several thousand volts when performing their function within the engine cylinder, and the testing voltages applied to the plugs in my tests were of the same magnitude.

Compression Adds to Break-Down Voltage

It is a matter of common knowledge that with the spark points of the plug set at a given distance, 0.025 in., for example, the break down voltage of the gap in air at atmospheric pressure is considerably less than that in air at a compression of 75-125 lb. Owing to the fact that the critical break-down voltage of the gap varies in accordance with the distribution of the electrostatic field between the plug points, and with the shapes and the areas of the surfaces of the points, it is impossible to assign a definite break-down gap voltage to spark plugs of different styles that would be applicable to all the different commercial types of plugs. In the limited number of plugs tested by me, usually the critical break-down voltage of cold plugs with a 0.031 in. gap. ranged between 3400 and 3600, depending upon whether the spark tips were blunt, sharp, edged, round balls, etc., and also upon the number of individual prongs. In order to subject the plugs to the higher voltages required to break down the gap under compression, the prongs were bent widely open and a thin mica tube of suitable diameter and length was inserted into the open cavity of the plug between the outer shell and the central stem of insulation around the central metal electrode. Thus protected the individual plugs examined by me, all readily withstood, at room temperature, an e.m.f. of 12,000 volts steadily applied between the central electrode and the grounded shell.

Since the ordinary bridge and galvanometric methods of measuring resistance are not suitable where testing voltages of 6000 V. are employed, the method used and described by the writer was chosen, which commends itself for its simplicity and convenience, as well as for the fact that the accuracy of the results obtained are amply sufficient. Further by this method one can obtain a permanent photographic record that is practically free from errors due to defective observation by the investigator.

The method is based on the fact, demonstrated many years ago by Lord Kelvin, that if the resistance R, the inductance L, and the capacity C of an electric circuit, such as shown in Fig. 1 have such a relationship that $R^2C>4L$, then the high tension charge of the condenser C will die away gradually, in such a manner that the discharge current is always in one direction. Since in our case the inductance consists of a few short pieces of stranded wire, the value of L is extremely small and may be neglected. Now if C, whose capacity in microfarads is accurately known, is charged to an accurately measured voltage and discharged through a very high resistance, such as the porcelain or the mica insulation in a spark plug, and if the time required for the voltage of the charge to fall to $1/\epsilon$ of its original value,* is accurately measured, then it can be readily proved mathematically that the time constant T of the condenser circuit equals $R\,C$. So that if we express T in seconds, R in meg-ohms and C in microfarads we have,

$$R_{meg}C_{mf} = T.$$

Or if the time required for the voltage to fall to $1/\epsilon$ of its original value is very long, owing to the very large value of R, a sufficiently accurate value of R can be determined by means of the well known formula,

$$R_m = \frac{T}{C_{mf}\ 2.303\ log\ \frac{V_1}{V_2}}$$

in which V_1 is the voltage to which the total capacity is charged; V_2, the voltage of the charge after the expiration of T seconds.

Measuring Instrument Described

Since the resistance of the plug insulation may lessen considerably when the plug is heated, thus permitting the charge of C to disappear within a small fraction of a second, means are necessary whereby both the changing voltage and the time can be simultaneously measured. To accomplish this, one of the elements of a part of the total capacity C is permitted to move from a position of wide deflection toward the zero through a microscopic distance as the charge in the condenser either slowly or rapidly dissipates itself through and over the surface of the insulation of the plug. By using a microscope to highly magnify the slight movement of the movable element of the condenser and projecting the shadow of the moving element, in our case a gilded quartz fiber—upon the horizontal slit of a drum camera behind which is placed a moving sensitive photographic film, the moving shadow inscribes upon the rotating film the exact curve of the dead beat discharge of the capacity C. To mark small fractions of time

*$e = 2.71828$, the base of Naperian logarithms.

during the discharge, the beam of light through the microscope is momentarily intercepted at definite intervals by the spokes of a wheel rotated at a uniform speed. The deflections of the above variety of condenser, which belongs to the electrometer type of instrument and is known as a string electrometer, can be adjusted to be either proportional to the *square* of the difference of the potentials of its plates and string (ideostatic connection), or the instrument can be made to give deflections which are directly proportional to the difference of the potentials of its plates, by using the Heterostatic connection and employing an auxiliary electric charge to the string from a battery of small dry cells sufficient in number to generate an e.m.f. of several hundred volts. As a matter of greater convenience in working, and owing to the fact that our high tension dry cell battery happened to be out of commission during the earlier part of the investigation, the deflection scale of the various curves reproduced in this paper is of the former type. The calibration, for example, is such that if an e.m.f. of 3000 volts is applied to the capacity C of which the electrometer forms a part, a deflection of 1 cm. from the abscissa is produced; with 6000 volts a deflection of 4 cm. occurs. The value of any millimeter line of the scale can thus be readily computed from the following equation:

$$\frac{V_1}{V_2} = \frac{\sqrt{D_1}}{\sqrt{D_2}}$$

in which D is the deflection in centimeters and V the volts. To calibrate the instrument an accurate Kelvin electrostatic voltmeter, indicating to 12,000 volts, was used. To charge the total capacity, consisting of electrostatic voltmeter, condenser, connecting cables and high tension switches, any high tension source of steady direct current may be used. A Wimshurst static machine was found extremely handy for this purpose by the writer. Fig. 2 is a diagram of the connections used during the tests.

Control Curve of Apparatus

As with all leakage methods in which high tension electricity is used, a so-called control curve of the apparatus should be made before any attempt is made to obtain actual data of the resistances and leakages of the plugs or of insulation of other nature. Fig. 3 shows the beginning and the end of such a curve occupying a time of two hours. During this time the deflected shadow of the string moved two millimeters and hence the drop in voltage during this time was only 153 volts. With such a small change occurring in such a great length of time, errors from instrumental leakage occurring during the brief period of time required for the capacity C to discharge through the resistance of the heated insulation of the plug would be negligible. In very humid weather, however, the surface leakage over the insulation of the apparatus may be considerable, hence the tests are performed preferably on days when the humidity of the air is low.

In Fig. 4 a cold (27.5 deg. C.) porcelain-insulated open-end plug with spark points widely separated is made a part of the capacity, and switch S_3 (Fig. 2) is closed. During a time of 13 min. the voltage dropped from 6000 volts to 5770. The resistance R is thus 133561.6 meg-ohms. By heating this plug to a dark read heat and letting it cool slightly until entirely dark, the discharge curve reproduced in Fig. 5 was obtained. The resistance in this instancee dropped to 18.94 meg-ohms. Curve Fig. 6 is from the same plug when at a dull red heat and its resistance has become still less, viz., 3.157 meg. In Fig. 7, the curve is from a well known European plug in which the insulator is supposed to be of steatite. Its cold resistance is 109090.9 meg. and when heated dark red, its measured resistance dropped to 13.68 meg.

Since the leakage rates of the various plugs whose curves are reproduced in this paper approximate that shown in Fig. 4, when tested in the cold state, their reproduction is omitted in order to conserve space, and discharge curves from the heated plugs only are given.

Curve of Red Hot Mica Plug

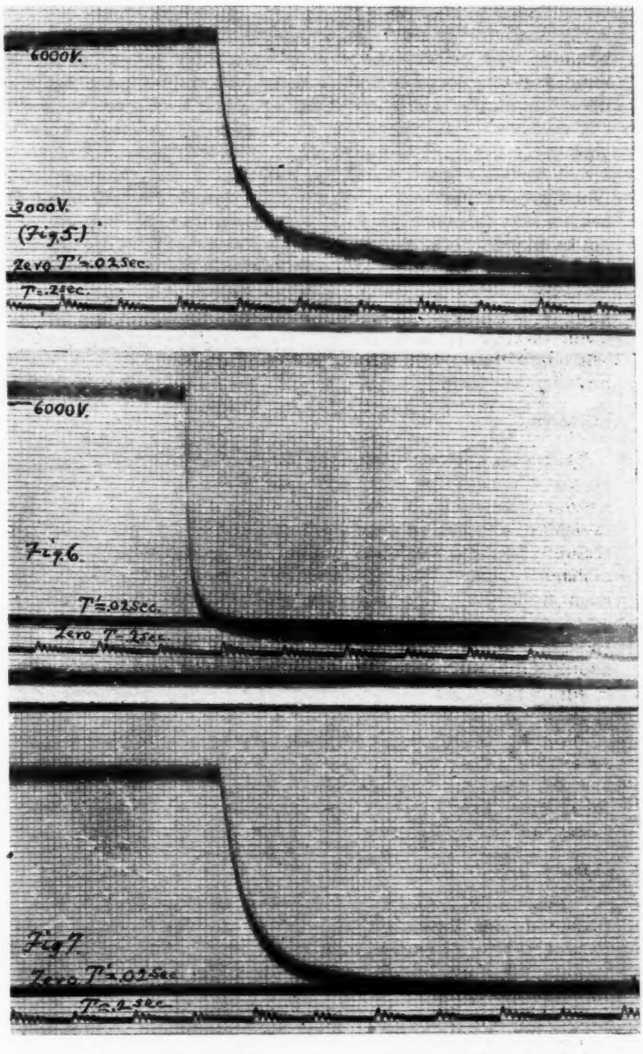
Fig. 8 is a reproduction of a curve obtained from a red hot new mica plug, which, even at a heat, probably never reached in a working combustion engine, still possesses a resistance of 333.684 meg. At room temperature the same plug showed a resistance of 202105 meg. prior to the first heating.

Now it must not be inferred that all porcelain and mica plugs when heated, behave exactly like the few samples whose test results are recorded in this article. Quite the contrary, for early in the investigation it became evident that the amounts of leakage occurring in the different plugs when heated to the same temperature varied considerably, even in plugs composed of apparently the same kind of material and with a fairly similar distribution of the dielectric material.

To determine such differences quantitatively for all the different dielectrics employed in commercial spark plugs would necessitate a great many time-consuming observations. The writer did not have time for such an extensive investigation, but hopes that the following conclusions drawn from the observations he made may act as a stimulus to those especially interested in improving the quality and durability of insulating materials used in spark plugs.

Porcelain

The resistance of all the plugs with porcelain as the chief insulator was very greatly diminished by heating. Even at temperatures from 130 deg. C. — 200 deg. C. the lessening of the resistance was quite noticeable, although possibly not of an order to seriously interfere with the production of an ignition spark when the source of current possessed the power of average commercial ignition outfits. However when one of these plugs with its points separated so that sparking occurred from the central electrode across the surrounding porcelain stem to the shell, was heated to dull redness (about



Figs. 5, 6 and 7—Leakage curves of porcelain plug below red heat and at a dull red heat and of a steatite plug

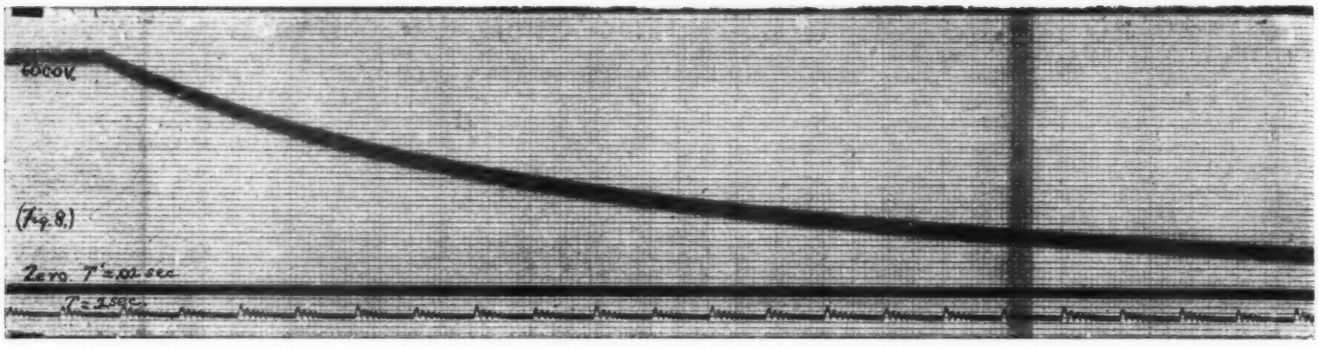


Fig. 8—Leakage curve of red hot new mica plug

500 deg. C.) and connected to one of the high tension leads of a very powerful high tension magneto of the shuttle armature type, even at a magneto speed of 1200 r.p.m., sparks similar to those of the cold plug could not be obtained. In the air space between the shell and the outer surface of the central insulation, innumerable fine reddish colored sparks were present, which continued for a few moments after the redness had disappeared from the cooling porcelain. As the plug cooled to darkness, the arc flame spark suddenly formed over the surface of the porcelain to the shell, the same as in the cold plug. It may be inferred that with a generator or induction coil of less output, before the sparking voltage over such a plug could be built up, a still further cooling of the plug would have to occur.

A further interesting phenomenon was also observed, namely, that on heating several porcelain plugs of different manufacture a number of times to dull redness, a progressive deterioration of the insulating qualities occurred, so that in the cold state the dielectric resistance was considerably less than before the plug had been alternately heated and cooled. From special tests made by the writer this change in the porcelain appears to be due not to the formation of surface cracks in the material, but to some molecular change of the material due both to the heat and to the passage of the current through the heated porcelain. How much this factor would influence the useful life of a porcelain plug under ordinary usage I am not prepared to state. Undoubtedly, however, this progressive deterioration would markedly shorten the useful life of such plugs when used in certain high-compression engines.

Steatite

Unfortunately only one specimen of this type of plug was at my disposal for examination. Broadly speaking, its behavior as regards its resistance was approximately equivalent to that of the better grade of porcelains. It apparently withstands heating somewhat better than most porcelains although when just below dark red heat, the leakage through it is sufficient to prevent the production of a spark by the average ignition generator. Although it deteriorated from repeated heating and cooling, the effect is not quite so pronounced as with porcelain. In the sample examined by me, a number of fine surface cracks appeared after the seventh reheat.

Judging from this single specimen, steatite seems to be somewhat preferable to porcelain, on account of its smaller loss of resistance from reheating, but the tendency to the formation of fine surface cracks after a few reheats is certainly not in its favor.

Mica

As was anticipated from our general knowledge of this substance as an insulator, the behavior of the various mica-insulated plugs was variable, and evidently depended upon the variety of mica used. Broadly speaking, the cold resistance of those new plugs in which apparently choice mica had been used was of a very high order, namely, 100,000 meg. or more. With some brands of plugs apparently insulated with mica of medium quality, on connecting the condenser charged to 6000 volts to the plug, the voltage would drop within 3 sec. or less to about 5000 volts, then more slowly until at the end of half a minute or slightly more, a voltage of about 4250 was reached. At this point the discharge through the mica practically ceased and the deflected shadow of the string would remain stationary for many minutes. Such plugs, therefore, if subjected in the cold state to a voltage not over 4250 at atmospheric pressure and with air as the medium between the electrodes would perform their functions perfectly.

Red Hot Mica Plug

Between the hot porcelain plug and the hot mica plug made of high grade mica, there is quite a contrast. Although the resistances of the latter plugs lessen considerably when at a cherry red heat, nevertheless the amount of leakage is usually insufficient to prevent the production of an effective spark ample when an energetic ignition outfit is employed. Thus when the mica plug from which Fig. 8 was taken, was heated to a bright cherry red and actuated by a high tension magneto giving a large secondary current output, the arc flame spark from the central electrode over the insulation and air space to the shell was practically undiminished as far as the eye could detect even at a magneto speed as slow as 50 r.p.m.

After repeatedly heating and cooling the mica plugs it was observed that their resistances when cold, like those of the porcelain plugs, progressively decreased although more slowly. Thus in the case of a high grade mica plug with an original resistance when cold of 202105.2 meg. after heating and cooling 15 times, the cold resistance was found to have dropped to 13684 meg. The resistance when hot of this plug is now 96.6 megs. In spite of this great drop in resistance this plug is still capable of performing its function in an engine.

Surface Leakage

As mentioned above, it is practically impossible to differentiate between the leakage that occurs over the surface and that through the substance of the dielectric, owing to the particular shape and dimension of the insulation. Certain porcelain plugs, however, after being tested, can be partially dismantled and an approximate idea obtained of the extent of leakage liable to occur when the greater part of the central metal electrode has been removed from contact with the insulation, the metal shell of the plug, being left in contact with the insulation. As is well known, in damp weather, before the engine has become warm, considerable leakage occurs over the moist outer surface of the plug. In a few minutes, however, this moisture is driven off by the heat and its effect disappears. When that part of the plug within the cylinder becomes really hot and is in contact with ionized gas, it is conceivable that considerable escape of the electric charge takes place over the heated surface of the insulator.

To investigate this question the resistance of a new porcelain plug was measured cold and was found to be 133561.6 meg. After being heated ten times to 500 deg. C. its total resistance cold was 8450.7 meg. Its resistance hot was 3.157 meg. The central stem of this plug was removed and its end-portions were sawed off. These end-portions were then replaced in contact with the respective ends of the hollow porcelain tube and held firmly in position by a semi-circular spring clamp to which the high tension lead was attached. The shell

of the plug was grounded through the high tension switch S_2 as usual.

The resistance cold of the plug was now 458015.2 meg. The total resistance being 8450.7, by the usual formula

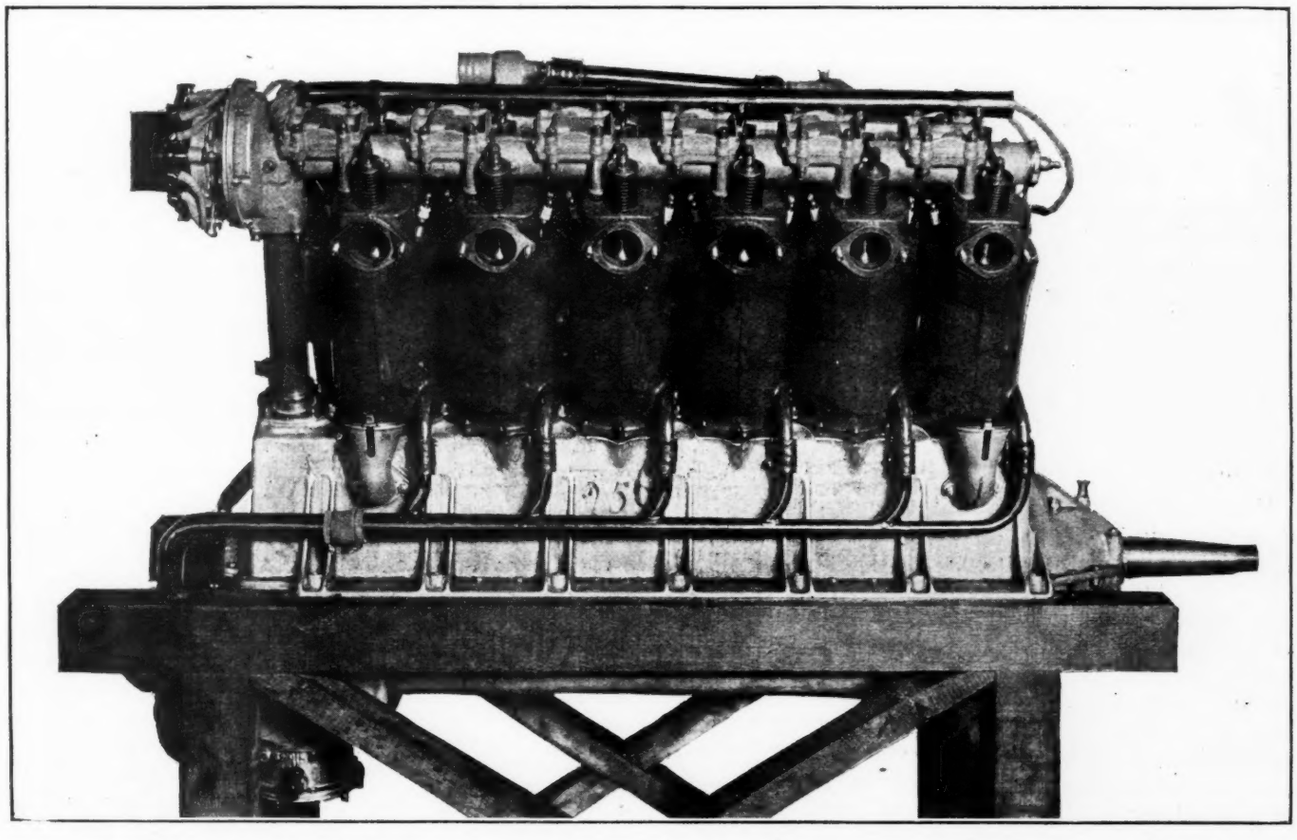
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

the resistance of the hollow porcelain was 8609.7 meg. The dismantled plug was then heated on its inner end to 500 deg. C. Its resistance R now measured 42.1 meg. Previously, its hot resistance was 3.157 meg-ohms, and by the above equation the resistance of the porcelain is found to be 3.41 meg. The surface leakage resistance in this case therefore was so great in comparison to that through the substance that it is negligible.

Stated broadly, the general effect of the leakage is to diminish the intensity of the current of the spark and when great enough, will cause complete failure of the spark. To get a clear conception of the somewhat complex phenomena concerned in the formation of the spark in the heated plug, it is better to recall to mind, first, the mechanism of spark production in the dielectric between the points of the plug in the cold state. This may be briefly summarized as follows: In the usual high tension ignition source, interruption of the primary current gives rise to a more or less rapid change of the magnetic flux in the iron core of the primary. Since the primary winding is surrounded by the fine wire secondary winding, both windings being magnetically fairly closely coupled, the changing flux generates by induction summative electro-motive forces in the numerous turns of the secondary winding. The resultant e.m.f. then forces the electric current through the resistance of the fine wire, until the distributed capacity of the winding, and the capacity of the terminals with the attached cables and spark plug have become charged to a voltage great enough to force the electricity in the form of a spark through the ionized gas occupying the electrostatic field between the plug points. If the resistance of the spark plug has become greatly reduced from heating, molecular deterioration, etc., the supply of current from the secondary may not be delivered rapidly enough to the leaking plug to attain the minimum voltage required to strike across the spark gap. Hence the spark would fail, the secondary current passing through the dielectric of the plug. If, however, the ignition source is capable of delivering a large quantity of charging current in a very brief interval of time, the effects of plug leakage are not so noticeable in practice, for in this case there is a greater likelihood of the sparkling voltage being attained in spite of the inappreciable quantity of current lost by leakage during the very brief time required for the plug-points to reach the requisite sparking voltage. After the passage of a spark between the plug points, the gap resistance, as is well known, falls for a time to the value of a few ohms; hence, although the heated dielectric of the plug is conducting a small proportion of the total current at this time, nevertheless its resistance in comparison to that of the gap is enormous; consequently, after the potential difference of the gap and its resistance have been lowered by the passage of the spark, only an insignficant quantity of current continues to leak through the dielectric of the plug.

Considering the above, it should be clear that where plugs are liable to become red hot by reason of high compression or other causes, it is advisable to employ an ignition source that is capable of delivering an extremely steep front type of secondary voltage wave. Further, when current begins to flow in the secondary windings of such a source, the reaction of its magnetic field upon that of the primary core should by no means be strong enough to inhibit the change of flux in that core.

Side View of Liberty Aircraft Engine



The Liberty engine, which was pronounced one of the greatest achievements in aircraft engine design by both foreign and domestic experts, is a twelve-cylinder Vee engine with 45-degree angle of Vee. It has hydraulically forged steel cylinder with welded-on sheet steel water jackets. With cylinder dimensions of 5 x 7 in. the engine develops over 400 hp. and weighs less than 800 lb.

Labor Is Not a Commodity

It Is a Service Involving the Ambitions and Aspirations of the Individual Worker—Formation of a Permanent Co-operative Organization to Solve Labor Problems Unapproachable Until This Is Understood

By Harry Tipper

THE sudden entry into the period of readjustment indicates that the labor problem must be faced, and faced immediately. The cancellation of contracts which are not yet in production, the arrangements for the gradual reduction of other contracts, and the necessity for the absorption of this labor in other work indicate that the turnover of labor is likely to be increased; difficulties on rates of pay and a slacking up of efficiency in production are likely to come up continually for discussion and adjustment.

The question of the rapidity of a reduction in the rates of pay is a point about which some emphatic opinions have been expressed already by representatives of manufacturers' associations and of labor organizations.

It is evident that if the cost of living is to enter into this question of pay the matter may depend upon the financial condition; that is, the inflation of values due to the enormous reserve of gold concentrated in this country by the exigencies of war in a greater measure than the desires of the different lines of production to enter upon a reduced scale of costs.

It is not yet apparent that we shall have any surplus of labor, and the condition in this respect will not be apparent for some months. There are many lines of industry which have been suppressed to a considerable degree by the necessities of war, even if they have not been entirely stopped. And there is a deferred necessity of production in such lines which will demand a large increase in the amount of labor involved.

Temporary Labor Surplus Possible

It is possible that a waiting tendency in the period of first attempts to analyze the readjustment necessities may provide a temporary surplus of labor in some lines, but there is no evidence at present available which would indicate any immediate general surplus leading to any large degree of unemployment.

These are of course only speculations, as the figures available for the different industries are not sufficiently complete and comprehensive to permit a proper estimate of the deferred necessities and a proper estimate of the release of labor from the war industries. The position, however, does indicate that some time is afforded the manufacturer before these adjustments become acute to lay his plans for an attack on the future labor problem so that the later period of readjustment will not find him unprepared.

It is necessary, in order to place at the service of the manufacturer the types of organizations which have been considered and adopted in individual cases with notable success in some lines of industry, to depart for the time being from a further discussion of the fundamentals governing the growth and position of labor organizations and discuss the character and validity of some of these plans.

Organized Labor Totals 14 Per Cent

The percentage of organized labor in this country is estimated as 14 per cent of the total available labor. However, in some occupations the organized labor is a very much larger percentage and is sufficient practically to control the operations of labor in that particular field. It is also true that an organized minority in periods of readjustment can control the actions of an unorganized majority when the problem becomes sufficiently acute. It is to be noted further that even in industries where the labor is not organized to any considerable degree the workers of a particular plant or locality are induced to get together in some temporary form of organization when the acuteness of the problem demands some action.

Any plan considered by a manufacturer to deal with the labor problem should be based, of course, upon the probable effect of such a plan in influencing the turnover of labor, the productive efficiency, the cost in units of production in comparison with other competitive organizations, the permanence of the machinery of adjustment, and the capacity for adjustment without interruption of the productive necessity.

Such a plan therefore must take into consideration the fact that organization of labor has increased almost 50 per cent since the war broke out in the official record of the occupational organizations, and that this increase is very greatly enlarged if it be considered to include the temporary organizations created for the purpose of settling disputes which have arisen in one occupation or another in various localities.

In fact, the manufacturer must be prepared to admit that some form of organization among the workers is likely, is to be expected, and must be considered in the formation of any plans to deal with the subject.

The question, therefore, is not a question of fight-

ing the organization of workers, but of meeting the present organized bodies of labor which are not capable of solving the problem for the individual manufacturer, and which are just sufficiently strong to disturb the normal operation without having the power to govern the practice thoroughly with a form of organization which will offer a prospect of solving these questions of stability, incentive, turnover, productive efficiency, etc., in connection with the individual manufacturers' organization, and which will at the same time provide the worker with a voice in the settlement of the conditions of his work at least as important as the voice which he secures in the determinations of his occupational labor organization.

Such an organization, moreover, should be of a character sufficiently permanent and continuous in the working of its machinery, to settle many questions before they have arrived at the point of disputation, and have created the mental dissatisfaction or the physical interruption which seriously disturbs the productive operations.

Immediate Results Impossible

It is not worth while to discuss any such plan without suggesting to the individual manufacturer that the results to be expected form an organization within the industrial manufacturing unit cannot be secured immediately. It is clear that during the first part of the life of such an organization the efforts of such a body would not offer any advantage over the present methods of settling the questions of dispute between employee and employer, and would not indicate any of the economic benefits to be derived therefrom.

Unless the manufacturer is prepared to decide upon an organization with full confidence that it is fundamentally right and possesses possibilities of growth which must make it of value in its economic effects, and is therefore prepared to spend the necessary time to establish the machinery to create the working understanding and to generate the confidence which must obtain before any advantage can be secured, the discussions which follow will have little of interest to him and will be of small benefit.

Some time ago a manufacturing organization where the employers were having a dispute with the employees which had resulted in a strike requested the writer to act in connection with the matter because of his knowledge of labor affairs. The request was refused because when the dispute had arrived at that stage an arbiter was necessary and not an organizer.

It is not to be expected that the plans lately announced by four or five of the steel companies and the plans now in motion by one or two of the oil companies and other industrial organizations will be sufficiently formulated in less than 3 years to have established a working basis that will offer any indication of advantage.

In some cases where there has been an atmosphere of confidence between the executives of an organization and its employees established through years of contact, the machinery provided by a plan properly thought out, for the co-operative solution of these questions, begins to show economic values more rapidly. Unfortunately, such cases are sufficiently rare in industries to make it necessary to emphasize the patience and the study which must be given to the building up of co-operative machinery within the industrial organization, which will provide a basis for the permanent adjustment of industrial relations.

It must be remembered by the manufacturer that the untold centuries of struggle by human beings to arrive at orderly systems of organization which will permit of individual development and at the same time emphasize the co-operative responsibility do not suggest any rapid solution of the whole of the difficulty.

Any of the plans adopted at present by the forward-looking individual concerns can be regarded only as a step in the right direction, and is a suggestion of machinery which can be employed to effect considerable progress in this matter and which will form the basis for future development along a hopeful line.

It must further be remembered by the manufacturer that a continuity of the present warfare between employers and employee, whether in thoroughly established organized groups or in temporarily organized bodies, will increasingly hamper the manufacturer in his industrial activities and remove from his control an increasing portion of this most important problem.

Labor Not a Commodity

It was stated in the first article written in this series that labor is not a commodity, but is a service performed by human beings involving their individual ambitions and aspirations, their social responsibilities and necessities, and their political opportunities.

No approach can be made to the organization of permanent co-operative machinery for the solution of this problem unless this is thoroughly understood. All economic results arise out of the satisfaction of these human instincts and are directly proportional to the degree of satisfaction or discontent. In the final analysis the problem of human labor is a spiritual problem, its causes buried in those deep-seated instincts of growth and development which distinguish the thinking animal.

After all, however, it is true in human affairs as in mechanical affairs that the practical application of the principles limits their usefulness. The next article, therefore, will begin a discussion of various plans of industrial organization, analyzing their advantage and disadvantage and the difficulties which have grown out of their existence, as well as the possibilities expressed in their future.

This discussion will begin with the usual industrial organization and the modifications which have occurred in the last 25 years, so that upon this background the individual plans which have been created in some concerns in various lines of industrial work can be thoroughly considered, showing their departure from the usual method, the reasons for that departure, the advantages and future possibilities.

Four Hispano-Suiza Models

Lightness, Flexibility and High Mean Effective Pressure Features of This Engine for Fighting Planes

THE Hispano-Suiza is notable for unusually light weight, great flexibility and high power per unit of piston displacement. Simplicity of design and ease of manufacture are also claimed for it. Its simplicity may be judged from a comparison of its number of parts with that of another well-known engine. It is stated that the Mercedes aircraft engine has approximately 900 parts to 400 in the Hispano-Suiza.

All Hispano-Suiza engines are manufactured under the Birkigt patents, which are owned by the Swiss designer, Marc Birkigt, formerly a designer of mining machinery, and the parent company, Automoviles Hispano-Suiza, the builder of the four-cylinder automobiles of that name before the war, with factories at Barcelona, Spain, and Paris, France. The French factory was turned over to the manufacture of Gnome aviation engines shortly after the outbreak of the war. The Hispano-Suiza engine was not adopted for the French air service until December, 1915.

When European factories proved unable to meet the demand for Hispano-Suiza engines in 1916, manufacturing rights were given to the Wright-Martin Aircraft Corp., New Brunswick, N. J., which completed several orders for the French Government. Later, when the United States entered the war, these engines were turned out in large numbers for the American Government.

French aviators quickly took to the Hispano-Suiza engine, and it became the favorite for fighting and pursuit work, especially when fitted to Nieuport and Spad planes. It was used by practically all the leading French aces, some of the most famous being Fonck, Guynemer, Nungesser and Lufbery.

There are two outstanding features common to all Hispano motors, these being the cylinder construction and the method of valve operation. The cylinders are separate steel sleeves flanged for attachment to the crankcase and with the valve seats cut in the heads, but instead of each cylinder having a sheet steel jacket welded to it, it has the customary design for aviation engines. The water jacket is an aluminum casting which makes the cylinders into a block. The cylinders are threaded externally for the greater part of their length and screw into the aluminum casting. This construction means that all working stresses are cared for by the steel sleeves, the aluminum casting having nothing to do except retain the water and carry the camshaft.

The valves are set in a straight line in each cylinder block, there being two to each cylinder, and their center lines are parallel to those of the cylinders. The stems are of very large diameter and hollow, and each valve carries a mushroom tappet screwing into the valve stem. The top of the tappet is hardened, and the camshaft, being mounted directly on top on the cylinder block, operates the valves by direct contact between the cams and the tappets.

Each tappet is serrated on the under side of its head and a serrated washer lies immediately beneath the tappet head. Under the washer are two concentric valve springs. The upper end of the whole valve stem is welded and the washer has two projections which engage with the slots, so preventing the washer from turning.

To adjust the clearance between tappet and cam a special tool is used which makes its fulcrum on the edge of the washer which cannot turn relative to the valve and then tightens or loosens the mushroom tappet, the serrations slipping over each other.

Four models of the Hispano-Suiza engine have been built in the United States. These are the Models A, I, E and H.

Model A has a bore of 120 mm. (4.72 in.) and a stroke of 130 mm. (5.11 in.) and develops 150 hp. at 1450 r.p.m. at sea level. Although formerly used for combat and pursuit work this engine has now been relegated to use in training planes.

Model I, also of 150 hp., is the same as Model A except that it has the new marine type of connecting rod; the magneto drive and the timing are different, and there are some slight changes in the piston mounting.

Although Model E has the same bore and stroke as Models A and I, its output is 180 hp., the compression ratio having been raised from 4.72 to 1 to 5.33 to 1 by increasing the distance from the center of the piston pin holes to the top of the piston. A large Stromberg carbureter (2 in. barrels) allows of high volumetric efficiency even though the speed of Model E is 300 r.p.m. greater than that of the Model I. Model E has been extensively employed in the British SE-5 planes, which are built for fighting and general purpose work.

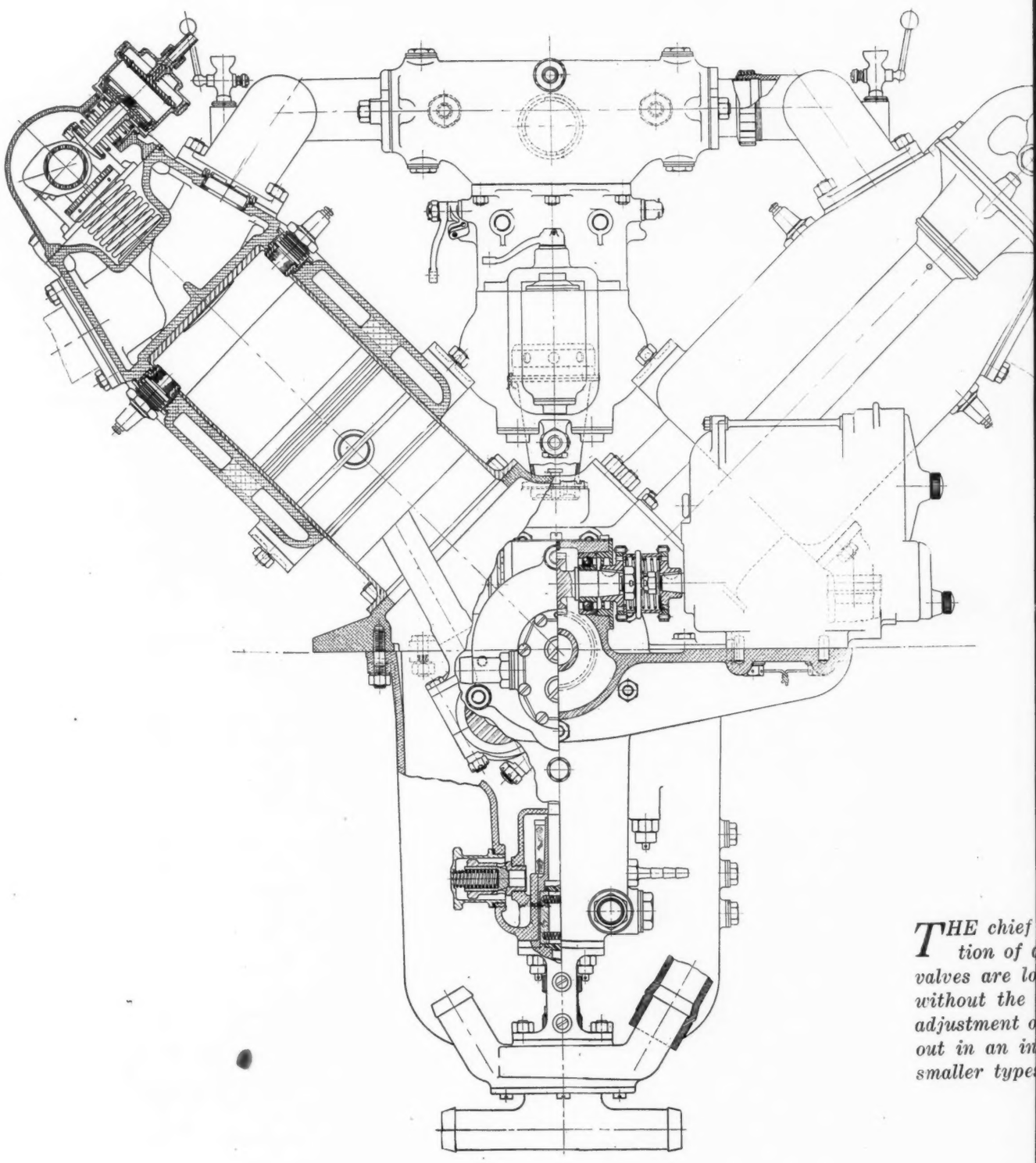
All three of these models resemble the original design in their essential features, although many details are different.

Model H, which is the 300-hp. model, is of American design except for its basic principles. Twenty-two of these engines have been completed by the experimental department at the Wright-Martin factory in New Brunswick, and tests have shown them to be very speedy and powerful. Model H has a bore of 140 mm. (5.511 in.) and a stroke of 150 mm. (5.905 in.), and differs from the other models also in the design of its carbureter and oiling system.

With the exception of the points of difference outlined above, the Model I may be taken as typical. The two halves of the aluminum crank case are ground so that their faces make a perfect fit, no gasket being used between them. The lower half of the crank case is very deep, forming a large oil reservoir and also serving to impart greater rigidity to the engine.

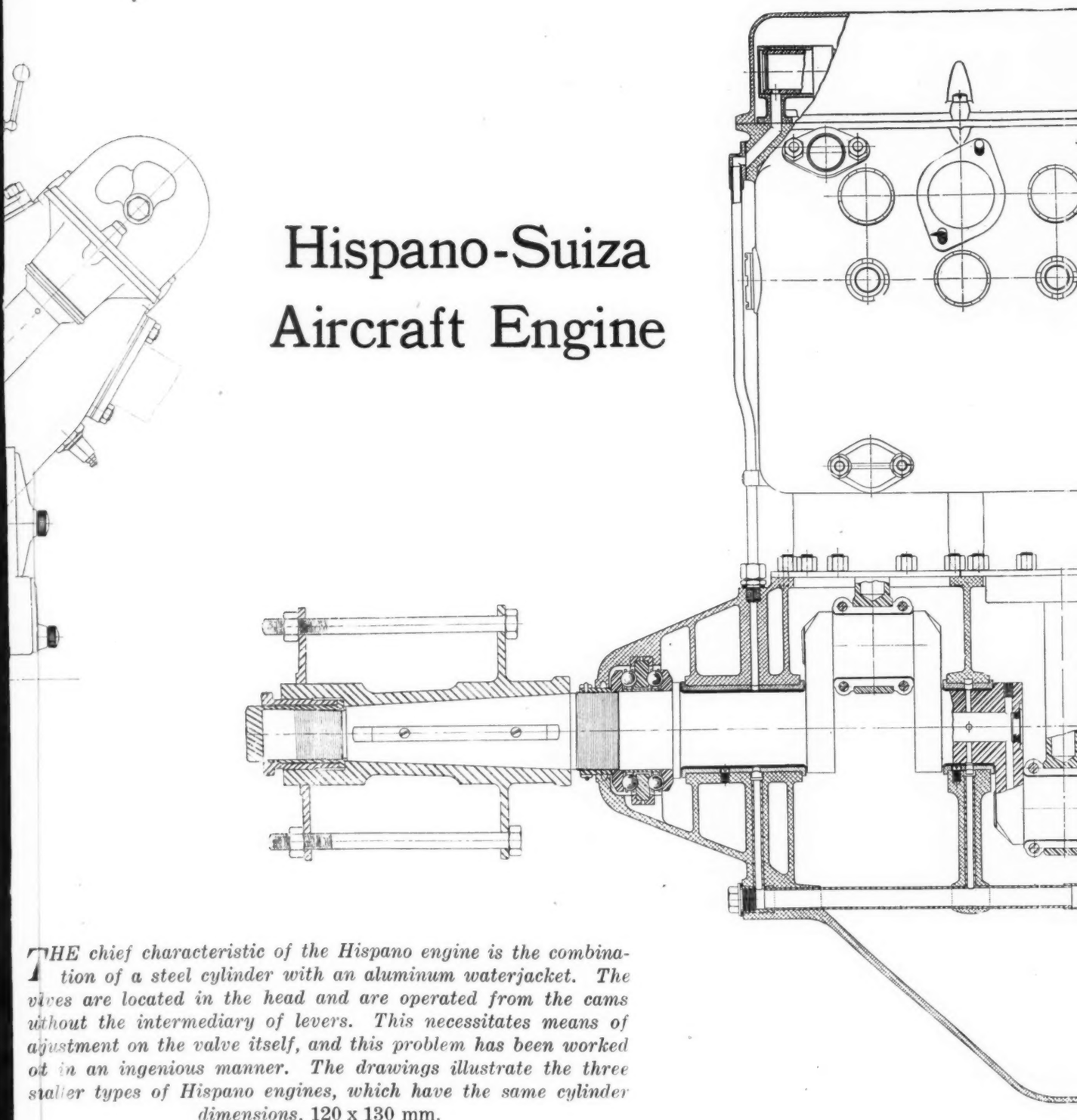
The cylinder blocks are of cast aluminum and incorporate waterjackets surrounding the heads of the forged steel cylinders, which are made in the form of sleeves threaded on the outside to screw into corresponding threads cut in the aluminum waterjacket. Each cylinder is flanged at the bottom and closed at the top, the upper surface being flat and containing the two valve seats. The cylinder blocks also embody the intake and exhaust passages and the valve ports.

A hollow four-throw crankshaft is used, 180 degrees between throws, the material used being chrome nickel steel, machined all over. Four plain main bearings, bronze-backed and lined with babbitt, and one annular ball main bearing at the rear (magneto end) of the engine carry the shaft, which is supported between the

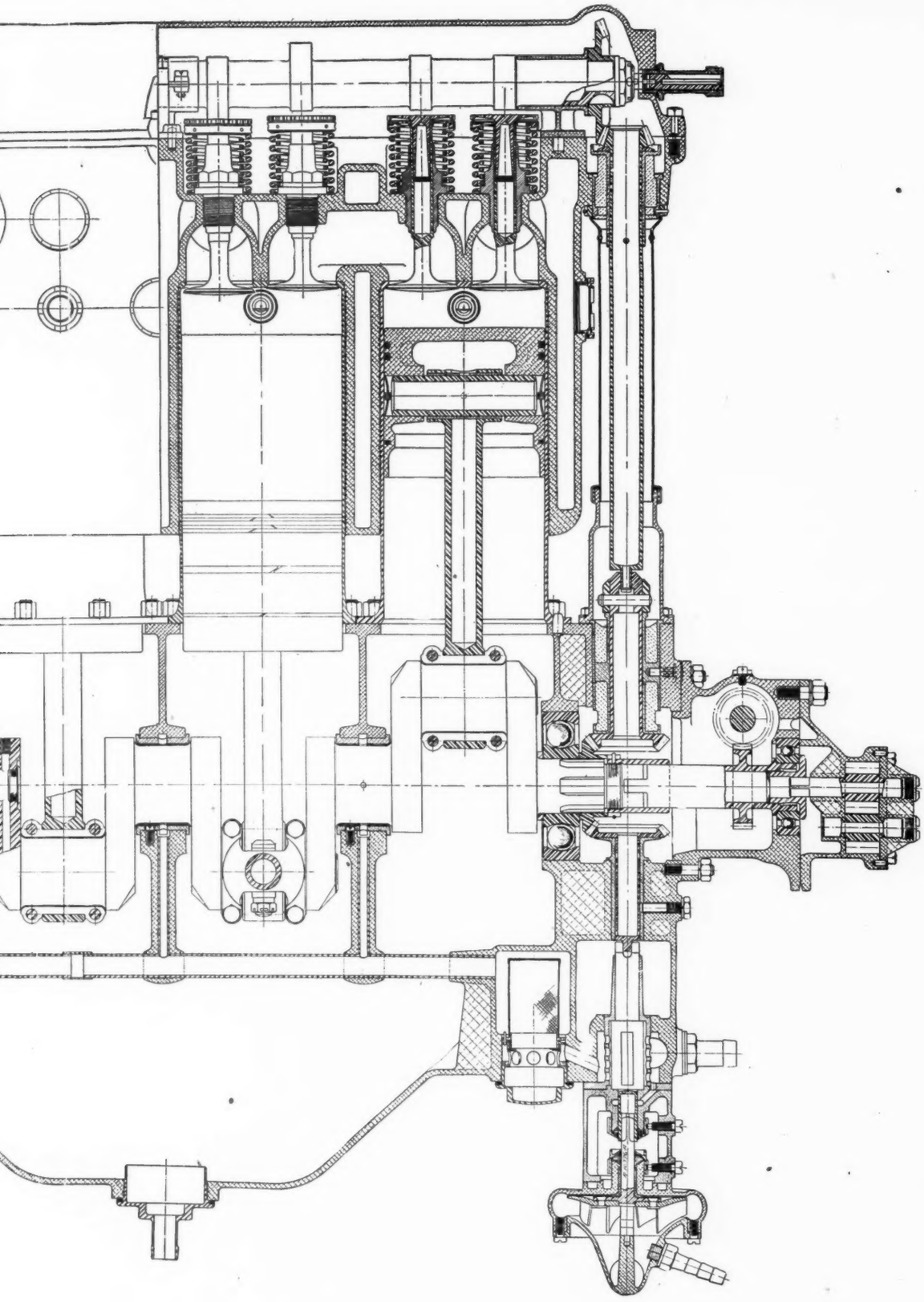


THE chief
tion of
valves are lo
without the
adjustment o
out in an in
smaller type

Hispano-Suiza Aircraft Engine



THE chief characteristic of the Hispano engine is the combination of a steel cylinder with an aluminum waterjacket. The valves are located in the head and are operated from the cams without the intermediary of levers. This necessitates means of adjustment on the valve itself, and this problem has been worked out in an ingenious manner. The drawings illustrate the three smaller types of Hispano engines, which have the same cylinder dimensions, 120 x 130 mm.



crank case halves. A double-row, ball-thrust bearing located in the front of the crank case takes the thrust of either a tractor or pusher propeller. The crankshaft is provided with a taper at the front end, having a key for the propeller hub.

Connecting rods are tubular. The new type of rod, which is of American design, is forked at the bottom and bolted to a two-piece bronze box lined with babbitt, two bolts being used at each side. The bronze box bears directly on the crankshaft and the other connecting rod bears on the outer and central portion of the bronze box, the shaft itself working between the forked ends of the straddle rod. Bronze bushings are provided at the upper ends of each pair of connecting rods.

Piston Walls Tapered

The cast aluminum pistons are ⅜ in. thick at the head, this thickness tapering at the sides to ⅛ in. at the bottom. There are four narrow rings in two grooves at the top of each piston, and near the bottom there is one oil ring with a relief just below it. Case-hardened alloy steel is used for the piston pins, which are of large diameter and hollow in construction. These pins float in both sides of the piston as well as in the upper end of the connecting rods, a piston pin lock ring holding each pin in place.

A hollow overhead camshaft operates the valves in each cylinder block, being carried in three plain bronze bearings and driven by two pairs of bevel gears and a vertical shaft at the rear of the engine. These vertical shafts are protected by light steel tubing, and each is made with a screw driver, or Oldham coupling, type of joint slightly below the middle to permit removing the cylinder blocks without dismantling other parts. One of the camshafts—that in the left hand block—besides operating the valves, drives the piston of a small air pump mounted on the valve gear housing. This pump is used for maintaining pressure in the gasoline tank where the pressure fuel feed system is used. The oil-tight cast aluminum housings which inclose the camshafts and valve mechanism are easily removable.

Valves Direct-Operated

Tungsten steel valves with large diameter hollow stems are used, working in cast iron bushings. They are set parallel to the cylinder axes and the overhead camshafts operate them directly by making contact with case-hardened, flat-headed adjusting disks at the upper end of the stems, rendering rocker arms unnecessary. Each valve is held to its seat by two concentric helical springs, either one of sufficient strength to insure proper seating if the other breaks. Clearance between the cam contour and the adjusting disks may be easily corrected when necessary by means of serrated washers pressed upward by the springs which hold the adjusting disks in place, permitting easy turning with a special wrench which displaces the adjusting disks angularly in the valve stems. The whole assembly can slide freely lengthwise, although the spring retainer washer is held in place angularly by tenons engaging slots in the stem.

The inlet valves open at the same time that the exhaust valves close, 10 deg. after top dead center. The exhaust valves open 45 deg. before bottom dead center and the inlet valves close at 50 deg. after bottom dead center.

Pressure Oiling

Lubrication is by pressure, a sliding vane eccentric pump mounted vertically in the lower half of the crank case, directly under the rear end of the crank shaft, forcing oil to the bearings, etc. This pump is driven at 1.2 times crank shaft speed by the same bevel gear on the crankshaft that drives the vertical shaft at the rear of each cylinder block. Where an oil radiator and reserve reservoir are used, practically no oil is carried in the sump of the crankcase, this being known as the dry sump system. In this case the oil is circulated through the oil radiator and reservoir by a gear pump situated on the magneto support bracket at the rear of the engine and driven from an extension of the crankshaft.

Oil is driven first from the vane pump through the filter in the lower half of the crankcase and then through a steel tube cast in the lower half of the case with connections leading to three of the main bearings, where the oil enters the hollow crankshaft and is distributed to the four crank pins. Oil is fed to the outer connecting rods through holes in the inner rod and is then diffused as a spray which combines with the oil thrown from the main crankshaft bearings to lubricate the cylinders, pistons and piston pins. At the front main bearing there is a by-pass leading around the outside of the bearing to a tube which runs up the front end of each cylinder block, the lubrication of the bearing itself being taken care of by an oil lead. Passing up the tube at the front of the engine, the oil is delivered to the hollow camshafts which distribute it through small holes to the bearings, cams, valve tappets and stems, the excess oil escaping through the rear end of the camshafts in the form of a stream which lubricates the vertical shaft bearings and driving gears before returning to the crankcase through the vertical shaft housing at the rear of the engine. The filter in the crankcase is fitted with a removable screen to permit easy inspection and cleaning.

Transverse Shaft Drives Magnetos

The two eight-cylinder Dixie type 800 magnetos are carried on a bracket at the rear of the crankcase. They are driven at crankshaft speed by a transverse shaft through gear type couplings. A small shaft at right angles to the transverse shaft is located directly beneath it in the center of the magneto support bracket and communicates the drive from the crankshaft to the transverse shaft by means of a helical gear. The left hand magneto runs clockwise and the right hand one anti-clockwise. Each magneto supplies two spark plugs in each cylinder, the plugs being located in bushings in the aluminum cylinder blocks. One of the bushings is on the inboard side of the combustion chamber and the other on the outboard side.

The firing order is as follows, L indicating the left hand block and R the right hand block, facing toward the propeller end of the engine and the numbers denoting the position of the cylinders, facing toward the rear of the engine: 1L-4R-2L-3R-4L-1R-3L-2R.

The spark advance on the Models A and I is 20 deg. and 20 min. before top dead center. That of the Model E is 25 deg. before top dead center.

Starter Equipment

Equipment with an electric or air starter is made possible by bolting a suitable bracket in place of the magneto support and oil pump assembly. A single-unit motor generator system may be used for a combination starter and long distance wireless outfit, as the magneto wireless connection has a radius of only approximately 5 miles. Engines used in pusher type seaplanes are sometimes equipped with a geared-down hand starting crank with a small magneto to give a hot spark at low speeds.

When arranged for gravity feed, the gasoline tank is placed so that it will give 1 to 2 lb. head at the carbureter for any position of the machine when in flight. Where pressure feed is used, the pressure is maintained by the pump located on the valve gear housing of the left hand

(*Continued on page* 946)

Factors Concerned in the Causation of Industrial Accidents

The Results of Investigations Among British Munition Making Establishments—How and Why the U. S. Bureau of Labor Differs with Some of the Conclusions

OF the many valuable contributions to the literature of industry which have come into being in the form of reports of the Health of Munition Workers Committee of the British Ministry of Munitions, by no means the least enlightening is the record of the investigation of the factors concerned in the causation of industrial accidents by H. M. Vernon, M.D. It is one of the many studies made by various authorities on different phases of the problem of conserving health and energy among the munition workers. The investigation covered by the report under consideration was made to determine, by means of a study of the distribution of accidents and output through the hours of the working period, the importance and effect of certain factors which influence accident occurrence.

During periods ranging from 9 to 21½ months, 50,093 accidents, occurring in four munition factories, were analyzed. The injuries considered were cuts, foreign bodies in the eye, burns, sprains and injuries incurred one or more days before they were reported.

Dr. Vernon, in his report, states that the factors concerned in accident production may be classified as:

1. Those of personal origin (such as nervous and muscular co-ordination in relation to speed of production, fatigue, physical influence, nutrition and alcohol consumption).
2. Those depending on external conditions not directly under the worker's control (lighting, temperature, humidity, ventilation and defects of machinery and absence of suitable protective mediums).

During the investigation, according to the report, "No attempt whatever was made to investigate certain factors such as defects of machinery and absence of guards."

The Relation of Accident Occurrence to Output

The conclusion of the investigator is that most industrial accidents may be regarded as unavoidable and that "accidents depend, in the main, on carelessness and lack of attention of workers." In considering the relationship of the number of accidents to output, it developed that in one factory making fuses, during the morning hours the number of accidents increased with the output, and both accidents and output reached a maximum in the last or next to the last full hour of work. The conclusion arrived at by the author was that this increase of accident was "due partly to increasing speed of production and partly from increasing inattention arising from the thought of pleasure to come." It was found that among night workers, on the other hand, while the output followed a course similar to that of the day shift, the accident incidence, except that of eye accidents, was entirely different. It was found that the greatest number of accidents happened at the early part of the shift, and that the number gradually fell off during the night to about one-half of its initial value. The author attributes this to "the fact that the night-shift workers started work in a careless and excited state and calmed down gradually during the night."

In the other three plants, where 6, 9.2 and 12-inch shells were made, the hourly variation in the speed of production was very small, and the accidents incidence correspondingly steady.

The influence of fatigue on accidents to women was shown by the fact that the 12-hour day worked in the fuse factory caused such fatigue in the women as to make the number of accidents occurring among them 2½ times as great as in a subsequent period during which they worked a 10-hour day. Reduction of hours from 12 to 10 per day had no effect on the number of accidents among the male workers. The report states that:

> Even during the 10-hour day the women showed distinctly more signs of fatigue than the men did during the 12-hour day, not only by reason of the above-mentioned ratios between afternoon and morning accidents, but because the women showed a more rapid increase of accidents in the course of the morning spell of the 10-hour day than the men did in the same spell of the 12-hour day. Probably women would need to have their working day reduced to 9 hours before they escaped fatigue as successfully as the 12-hour day men. A 12-hour day of actual work in industrial pursuits was almost unknown in this country before the War, and has beeen exceptional during the War, so we may confidently conclude that as a rule fatigue has but little influence in the causation of accidents in men. If men worked longer than a 12-hour day, or even if they worked 12 hours or less upon heavier types of work than those imposed on them at the fuse factory, they would doubtless be liable to fall into the condition of excessive fatigue shown by the women.

Artificial Lighting Cause of Accidents

In a discussion of the comparative frequency of accidents among the day shift and among the night shift, Dr. Vernon states that the alcohol consumption factor, in so far as it operates at all, must tend to increase night-shift accidents more than day-shift accidents. Artificial illumination, he said, had the same tendency; the excess of eye accidents occurring during the night shift over those occurring during the day shift was shown to be due to artificial lighting. The report states that temperature had a decided effect on accident occurrence, since "accidents increased considerably as the weather grew colder, and diminished as it grew warmer. In one factory, accidents among women were nearly 2½ times as numerous when the temperature was at or below freezing point as when it was above 47 degrees, while among men they were twice as numerous." The author points out that inasmuch as lower temperatures were experienced during the night-shift hours, accidents would tend to be more numerous then, and after study of accident incidence at various temperatures he recommends as the optimum temperature in munition factories one of 60 deg. to 64 deg. F.

Notwithstanding all these factors tending to increase night-shift accidents over day-shift accidents, it was found that, grouping all kinds of accidents together, fewer accidents—16 per cent less among the women and 15 per cent less among the men—occurred during the night shift than during the day shift. The author concludes that the determining cause was the influence of the psychical factor—the workers' mental attitude.

The following suggestions as to accident prevention are given:

> In the first place, it is well to recognize that many industrial accidents, probably the majority of them, are unavoidable, and that at best one can only hope to reduce their number, and never to eliminate them entirely. Moreover, we have seen that speed of production is an extremely important factor in their causation, and often the most important factor of all, so any improvement of

factory conditions which increases speed of production inevitably tends to a more than proportional increase of accidents. Accidents depend, in the main, on carelessness and lack of attention of the workers, and so the more one can eliminate this lack of attention and increase the concentration of the worker upon his work, the more will accidents be reduced. As has already been pointed out, one wants to induce in all the workers throughout their hours of labor the same mental outlook as is present in the night-shift workers in the early hours of the morning. These workers have for the most part forgotten the pleasures and excitements indulged in shortly before coming on to night shift, and they have nothing but an unexhilarating breakfast and bed to look forward to. Such a mental state is impossible of achievement by the day-shift workers, but something in the way of mental calm and equilibrium can be attained by stopping all conversation except that relating to the work in hand. If the workers would consent to it it would be a good plan to induce temporary deafness by plugging the ears, and so shut out the noise of the machinery, which is in itself an important cause of distraction and fatigue. Again, if it were practicable—though it is seldom that it can be so—it would be of value to shut out the sight of surrounding objects by separating the lathes or other machines from one another by partitions. The worker, left to himself without sound or sights to distract his attention, could then concentrate himself entirely on the work in hand. It might be said that the monotony would be so great that nobody would stand it, but would it not be better to work for two 3 or 3½ hour spells every day under such conditions if the worker could thereby earn as much as he does under present conditions in two 4-hour spells? However, these conditions are mentioned only as an ideal, which should be aimed at wherever possible.

The careless habit of mind can also be diminished by stricter sobriety. There can be no doubt that the less alcohol the worker consumes the better it is for the quality and quantity of his work, and for his accident immunity. This applies especially to alcohol consumed by the day shift in the dinner hour and by the night shift shortly before coming on to work. The inclination of the day-shift worker to drink during his dinner hour can be combated to some extent by establishing factory canteens, where good food is obtainable at cost price, or slightly below it. The worker would then find it more convenienf to stay in the works during his dinner hour than to go home, and so would escape the temptation of drinking. * * *

The production of excessive fatigue with its accompanying increase of accidents can be almost entirely avoided by choosing suitable hours of labor. It can also be combated by the introduction of seats for the standing workers to rest on occasionally when they are not actually working, and of the most suitable seats possible for sedentary workers. * * *

We have seen that even moderately defective lighting produced a considerable increase of eye accidents, and it is probable that it had some effect on other types of accidents as well, though it was not big enough to be detectable. Hence, the adequacy of the lighting of a factory should be tested from time to time by an expert, while the eye accidents could be reduced or eliminated by the use of suitable goggles. Though it might not be worth while to insist on the majority of workers using these goggles, it should be made a rule that they be worn by the grinders of tools and other specially exposed workers.

Following this, the report pointed out the importance of the temperature factor in accident causation, which, as the author said, was self-evident and needed no discussion. He suggested that thermometers be installed in the shops, and be consulted regularly by those in control of the heating.

U. S. Labor Bureau Differs

In a recent issue the Monthly Labor Review of the Bureau of Labor Statistics of the United States Department of Labor pointed out that some of the conclusions arrived at in Dr. Vernon's report were at variance in some particulars with those suggested by the compilations of the Bureau. The first difference noted was in regard to the importance of the interval after the nominal beginning of a working period in which the worker does not get at work. Dr. Vernon, on the one hand, thinks that the inclusion of this period in the tabulation introduces serious elements of error. The Bureau, on the other hand, holds that its data seem to indicate that the essential form of the distribution curve is not materially altered thereby. It is pointed out by the Bureau that it is the form of the curve, rather than the precise number of cases in a given division, that is the important matter.

The Bureau also differs with Dr. Vernon in his feeling that sufficient attention has not been given to the interval between the occurrence of an accident and its treatment at the dressing station. A large amount of material, based on dressing station reports, has been compiled by the Bureau, and independent reports made by foremen and casualty clerks have also been studied, without the finding of any material difference in the distribution curves.

Dr. Vernon gives much importance to the mental attitude of the worker in certain cases. He says "inclination drove the day-shift women to attend the dressing station toward the end of the morning spell, but drove the night-shift women to attend it at the beginning," and "it follows, therefore, that in almost all accident statistics one must make a considerable allowance for these remarkable variations in the strength of the worker's inclination, though it is impossible to obtain a numerical measure of the extent to which inclination will falsify accident statistics."

The Bureau of Labor Statistics holds that "careful and extended experiment in the tabulation of various degrees of severity of accident, ranging from dressing station cases to those of not less than six weeks' disability, does not indicate that the influence of these mental states, though present beyond question, is of sufficient importance to modify the form of the curves.

The Bureau feels that Dr. Vernon has not given sufficient consideration to the importance of defects of machinery and absence of guards as causes of accidents. The other points of difference between the findings of Dr. Vernon and of the Bureau of Labor Statistics are set forth in the following paragraphs, which give first an extract from the former's report, and immediately after it the comment of the Bureau upon it.

Detailed Differences in Conclusions

Speed of Production.—The incidence of accidents (from hour to hour) showed a qualitative resemblance to the output variations, and it was concluded that varying speeds of production is the psychological responsibility for day-shift variations in accidents in men, though the night-shift output followed a similar course to the day-shift output, the accident incidence was entirely different. It was at a maximum at the beginning of the shift, and gradually fell the whole night through. This was due to the fact that the night-shift workers started work in an excited and careless state, and gradually calmed down during the night.

This contradiction between the day and night results is scarcely adequately explained by the difference in mood of the workers which is pointed out. That the situation is a very complicated one is further emphasized by the compilations of the Bureau, which indicate that for varied and extended kinds of work the morning spell presents two portions. In the first of these output and accidents both increase—accidents the more rapidly. In the second output continues to increase while accidents decline. Any complete explanation of accident distribution must take account of such cases as these as well as of those recorded in the memorandum.

Fatigue.—The influence of fatigue on accidents to women was strikingly shown in the fuse factory. The women's accidents were two and one-half times as numerous when they were working a 12-hour day as in a subsequent period when they were working 10 hours per day.

This, taken with other evidence presented and confirmed by the studies in other directions recorded in earlier memoranda, is a most important indication of the care needed in introducing women into work of this character. It is perhaps the most important practical finding of the memorandum.

Psychical Influences.—At all the factories the night-shift workers suffered fewer accidents than did the day shift. This was not because the output was smaller, as at the fuse factory it was distinctly bigger by night than by day. It was psychological in origin, and due to the night-shift workers settling down to a calmer mental state than the day-shift workers, and so becoming less careless and inattentive. The physical factor is one of the most important in accident causation.

Attention should be called to the fact that while these workers showed lower rates at night there are sorts of labor in which the night rates are constantly higher. It is difficult to understand why calmness should come at night to these workers and not to mechanics and toolmakers engaged in very similar tasks in other factories. It is impossible not to suspect that some other factor needs consideration.

Alcohol Consumption.—Indirect evidence as to the effects of alcohol consumption was obtained.

The conclusion of the author is that the influence of alco-

hol consumption is manifested more in the night shift than in the day. This conclusion is strongly confirmed by the experience of a large steel mill studied by the Bureau. In this mill it was found that the rates of discipline for alcoholic indulgence were from 2 to 10 times as great by night as by day. There was another interesting feature, namely, that both accident rates and the per capita use of alcoholics were declining during this period more rapidly for the night than for the day shift.

Lighting.—Accidents due to foreign bodies in the eye were 7 to 27 per cent more numerous in the night shift than in the day shift, though all other accidents were considerably less numerous. This was due to the artificial lighting, as the excess of eye accidents was most marked in the worst lit factory.

This is one of the most positive evidences of direct effect of lighting on the accident rate that have been offered. In most cases the lighting effect is so much complicated with other factors as to make it doubtful what its precise influence is.

Temperature.—Accidents were at a minimum at 65 to 69 deg. Fahr. and increased rapidly at higher temperatures and slowly at lower temperatures. Continuous records were kept of the town in which the shell factories were situated, and it was found that in all of them the accidents increased considerably as the weather grew colder and diminished as it grew warmer. In one factory the women's accidents were nearly two and one-half times as numerous when the temperature was at or below the freezing point as when it was above 47 deg., whilst the men's accidents were twice as numerous.

In this connection it should be stated that in steel mills extra men are frequently employed in the summer as "spell" hands to relieve the regular crew. This introduction of relatively inexperienced men may be quite as important as the direct effect of summer heat.

Prevention of Accidents.—Accidents are largely due to carelessness and inattention, so they could be diminished by preventing the workers from talking with one another in the shops.

It was found that the women suffered twice as frequently from sprains as the men, and were especially liable to wrist sprains at the fuse factory, as they had not strength sufficient to push home the clamping lever of the lathes. The women at the shell factories suffered nearly four times more burns than men, chiefly from hot metal turnings. Hence the sprains could be reduced by alterations in the machinery and the burns by protecting the hands.

The conclusion that "carelessness and inattention" are largely the cause of accidents is not borne out by the studies of the Bureau. It may be stated, however, that ignorance and inexperience are largely the cause of accidents and that adequate training in the skillful doing of work will diminish them. The more closely the accident problem is studied the more evident does it become that skill rather than care is the remedy so far as minor injury is concerned.

Army Airmen Fly Thousands of Miles

ARMY airmen are flying thousands of miles from field to field in the Middle West and Southwest, from the Atlantic to the Mississippi and through the Middle West and Southwest. Little is heard or seen of them even by the inhabitants of the country over which they pass. The following entries in the log of one airman who flew 1700 miles from Scott Field, Bellville, Ill., to Kelly Field near San Antonio, Tex., give a good idea of the work done in developing the school of the flier in America.

Captain F. M. Bartlett covered the 341 miles between Bellville and Clark Field, Memphis, in 3 hr. and 5 min. at an average speed of 110 m.p.h., favored by a stiff wind from the Great Lakes and at an altitude of between 7000 and 9000 ft. On the second leg of the trip between Memphis and Payne Field, West Point, Miss., wishing to stop for lunch, he descended and was close to the ground over an abandoned race track when he suddenly found the air so thin that he knew he could not get off this ground once he landed. He had difficulty in getting back to the upper air currents again, but by following a flock of birds which flew in an ascending circle, he secured enough altitude to continue. Approaching West Point, Miss., fine air was again encountered, but over this town he ran into an electrical storm and was forced to descend.

With clear weather the next day, he made the 230 miles between West Point, Miss., and Lonoke, Ark., without a stop, though his gasoline gave out just as he arrived over Eberts Field, which is near this point and Little Rock. Here bad weather held him up for 4 days.

The 450 miles of the next leg between Eberts Field and Post Field, Fort Sill, Okla., which had not been covered before in an airplane up to this time, proved the hardest task in his whole trip. He made the distance, however, in 9 hr. of difficult flying over the Ozark Mountains and came down at Hugo, Okla., for gas.

He had made his course straight from Little Rock over the Ozarks in the air line for Fort Sill, but with nothing but a rough carpet of high hills and thick timber under him as far as he could see, and on account of the bad weather he abandoned the air line to the west and veered to the south. In the 60 miles in this direction from Hugo he encountered a gale of such force as to fell trees below him. He attempted to rise over it, was caught in a large wedge of black clouds, held in the grip of the storm and for 35 min. hung over Arkadelphia, Ark. His plane settled from an altitude of 6000 ft. to 3000 ft. and drifted about 2 miles side-wise when he finally broke through the storm and came out miles off his course.

Between Fort Sill and Wichita Falls, Tex., he again met bad weather and had to be satisfied with a short mileage that day, not making Taliaferro Field, near Forth Worth, as he had planned. From the Falls this latter distance is 110 miles and Captain Bartlett again failed to make it on the day following, running into a stiff gale which held his ground speed down to 25 m.p.h. and he landed in the dusk at Bridgeport, just short of his destination.

The next day he made Fort Worth without trouble, but, leaving this post at 6.30 a. m., he encountered winds which shifted from south to east to north. This weather developed into a heavy storm and he was forced to land at Waco. Waiting here for the storm to pass he took off again under black clouds which hung as low as 600 ft. and with a strong south wind along the ground. He climbed to 3000 ft. and there found clear air and a brisk north wind. Corn husks blown from the ground followed him and various birds carried by this wind flew above him at 5000 ft., an unusual altitude for them. He finished his 1700-mile flight at 3.30 p. m., it having taken him from 6.30 in the morning to come from Fort Worth, a distance of some 295 miles.

A New British Coke-Fired Steam Commercial Vehicle

Three-Ton Chassis Having Automatic Control of Steam Generating Functions and Manual Control Devices Arranged the Same as on a Gasoline Vehicle

THOMAS CLARKSON of the National Steam Car Co., Chelmsford, occupies a unique position in the British motor vehicle industry. He was one of the pioneers in steam car development and has remained faithful to this form of motive power through all the years since the beginning of the industry in spite of the popular preference for "gas." Mr. Clarkson's work has been mainly in the field of commercial vehicles, and he has produced some very successful types, his London steam buses being particularly well known. His latest creation, the type IX chassis, is especially designed to meet war conditions in Great Britain. These conditions demand that a home-produced fuel be used, and the boiler is so designed that either solid or liquid fuel can be burned under it.

As there are a very large number of drivers accustomed to the control of gasoline vehicles, it was decided at the outset to standardize the controls of this new steam chassis, in order that a driver who has operated a "gas" vehicle can immediately operate the new vehicle, and will find each pedal and lever in the usual position and performing the same function as that to which he has been accustomed. In addition to the steering column there are a clutch pedal for the left foot, brake pedal for the right foot, side brake lever and change gear lever.

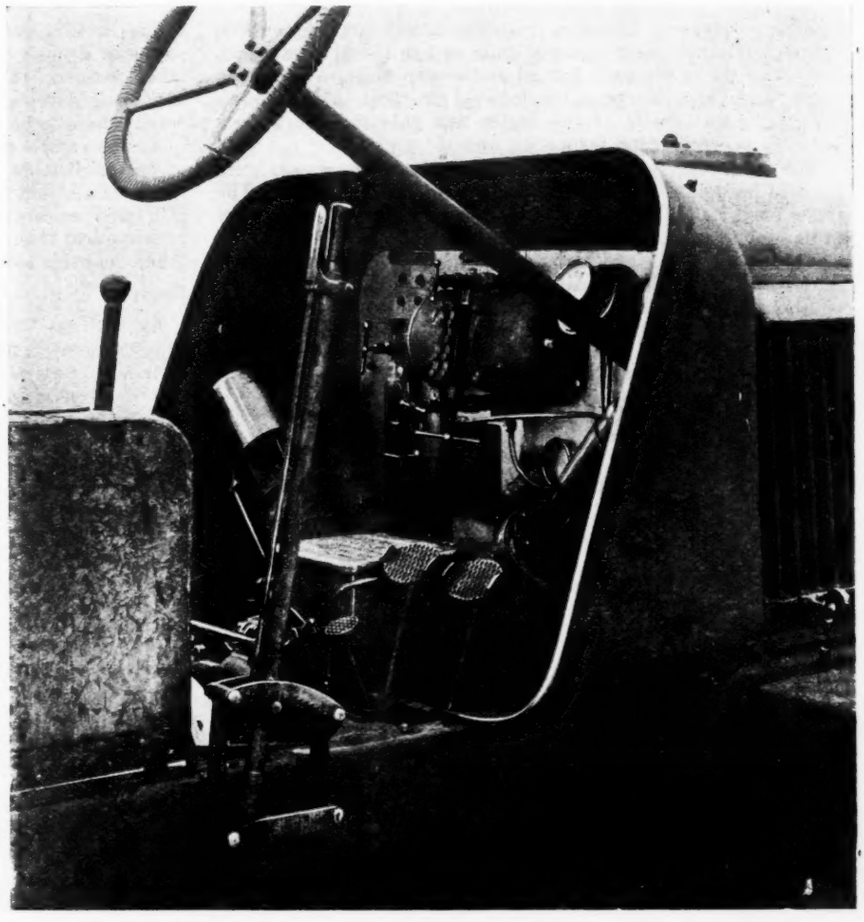
Experience having proved conclusively that an engine, whether steam or gasoline, cannot develop its full power unless it has sufficient piston speed, it naturally follows that in order to meet the extreme condition of heavy loads and soft ground, and light loads and hard ground, at least two gear ratios are necessary between the engine and the driving wheels. In the past it has been held that a steam engine having a wider range of flexibility than a gasoline engine could be fitted to a commercial vehicle without a gearbox, and many vehicles have been so constructed. It means, however, that in order to meet the heavy load and soft ground conditions a larger engine is necessary than would meet the ordinary working conditions, and one is led to the inevitable conclusion that an emergency gear ratio should be provided for this purpose.

Once we have admitted the principle of the gearbox to the steam motor two important further advantages can be immediately secured.

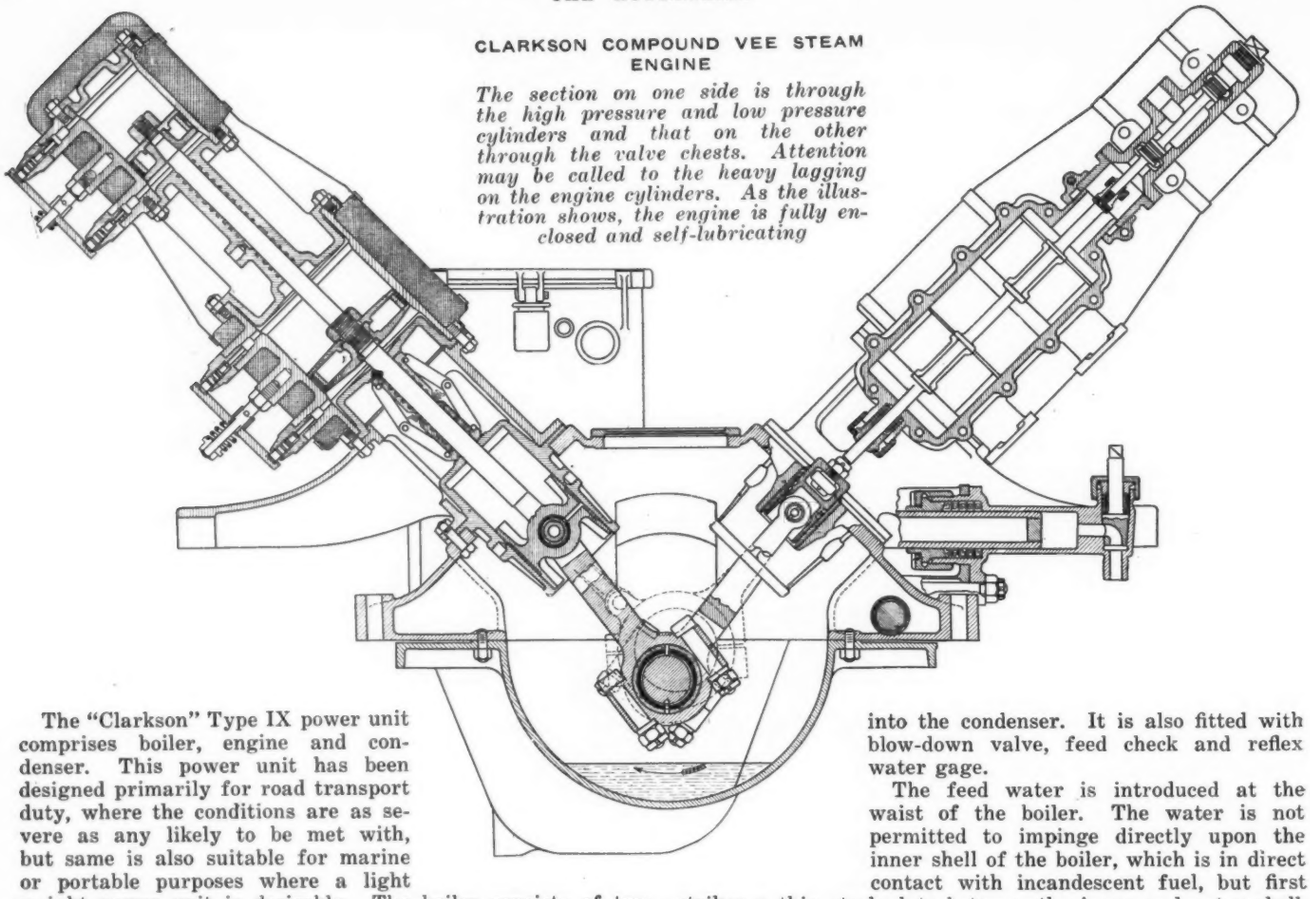
The construction of the engine may be greatly simplified by the entire omission of the reverse gear, the necessary reverse motion of the vehicle being obtained by the introduction of two additional wheels in the gearbox. It should be remembered that the reverse gear of an engine is rarely being used, but is always being subjected to wear. It is costly to make and to maintain, and therefore the employment of the one-direction engine is a distinct advance in simplicity and general efficiency.

The other advantage resulting from the adoption of a gearbox and clutch is that the engine can be run "free." This is useful not only for warming up in the morning, but when making long waits the engine can be allowed to turn over quickly, and in this condition the vehicle may be left for hours, the engine looking after the maintenance of water feed, steam pressure and lubrication.

In an actual test this chassis was left with steam up all night, the engine quietly turning round and regulating water feed, lubrication and steam pressure without any attention from the driver. In this condition the vehicle is instantly available for service, and the consumption of coke in turning the engine quietly round in this way is very small.



View of driver's compartment, showing location of engine and controls



CLARKSON COMPOUND VEE STEAM ENGINE

The section on one side is through the high pressure and low pressure cylinders and that on the other through the valve chests. Attention may be called to the heavy lagging on the engine cylinders. As the illustration shows, the engine is fully enclosed and self-lubricating

The "Clarkson" Type IX power unit comprises boiler, engine and condenser. This power unit has been designed primarily for road transport duty, where the conditions are as severe as any likely to be met with, but same is also suitable for marine or portable purposes where a light weight power unit is desirable. The boiler consists of two cylindrical steel shells flanged and bolted together at each end. The shells are each forged and drawn under a hydraulic press, and there is not a single weld or rivet in the boiler. When the two shells of the boiler are unbolted every part becomes accessible for inspection and cleaning.

The outer shell is formed with thickening belts where holes have to be drilled for the attachment of boiler fittings. The inner shell is drilled to receive water tubes which are of the "thimble" type, about 4 in. long and 1¼ in. average diameter. These water tubes are not expanded, but pressed into the inner shell and held in position (like the stones of an arch) by the pressure within the boiler. The working pressure is from *300 to 350 lb.* per square inch. The maintenance of this pressure is controlled automatically by an oscillating valve which regulates the draft of the fire according to requirements.

Boiler Fired by Solid or Liquid Fuel

The boiler is designed to be fired by either solid or liquid fuel. In the case of solid fuel it is fed through the central tube from the top. A superheating coil surrounds the central tube. The temperature of superheat is 620 deg. Fahr.

On a 3-ton coke-fired truck it is necessary to replenish the fire every 12 or 15 miles.

The supply of water to the boiler is by a pump operated by the engine at a reduced speed. The supply of water is controlled automatically by a reciprocating float which acts upon the foot valve of the feed pump in such a manner that as the float rises with the water level it prevents the foot valve returning to its seating. As a result the charge of water drawn into the pump barrel returns to the tank instead of being forced into the boiler until such time as the float descends and allows the foot valve again to become operative. This water control maintains the working level in the boiler without any attention from the driver.

Boiler Fittings

The boiler is provided with a safety valve of the dual locomotive type which discharges through a vacuum valve into the condenser. It is also fitted with blow-down valve, feed check and reflex water gage.

The feed water is introduced at the waist of the boiler. The water is not permitted to impinge directly upon the inner shell of the boiler, which is in direct contact with incandescent fuel, but first strikes a thin steel plate between the inner and outer shell, and any deposit from mineral salts contained in the water takes place on the thin steel plate, from which it is readily detached, and falls by gravity to the lowest part of the boiler, there to be removed by the blow-off valve.

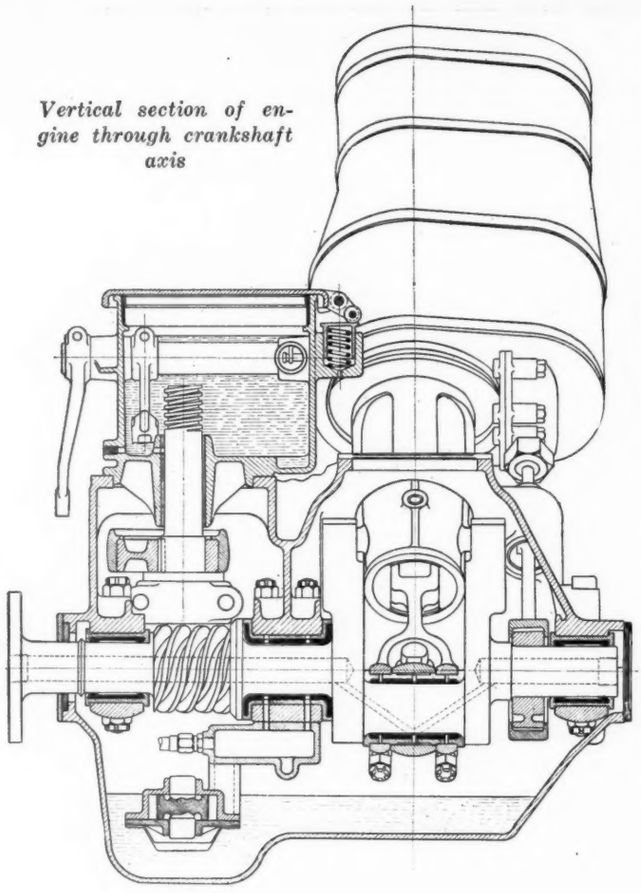
As the vehicle can travel from 30 to 60 miles on one charge of water (the mileage is dependent upon the character of the road and upon the load), it can easily be arranged to obtain supplies of clean water—there being no necessity to pick up supplies at short intervals on the roads from ponds and other doubtful sources.

Engine

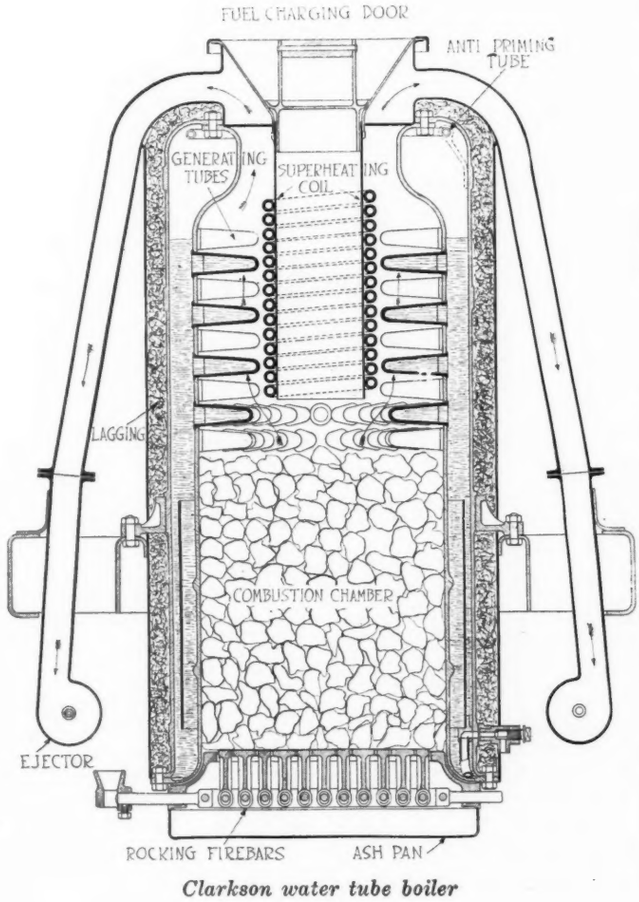
As will be seen from the drawings, the engine is a Vee type tandem compound. Two pairs of high and low pressure cylinders operate upon the same crank at an angle of 90 deg. A very even torque is obtained, as well as a nice balance, insuring smoothness of running and absence of vibration at speeds up to 1500 r.p.m. The engine has the following leading dimensions: High pressure cylinders 3 in. in diameter, low pressure cylinders 5 in. in diameter and a stroke of 3 in. for all cylinders. It is enclosed and self-lubricating. There are two systems of lubrication, cylinder lubrication and general lubrication. For cylinder lubrication a trigger pump is provided which is immersed in a bath of cylinder oil and which forces a drop of oil into the steam pipe every 100 revs., the rule being "little and often" so as to maintain a film of lubricant on the inner surfaces without having an excess.

For the general lubrication of the engine a gear pump is provided, this being submerged in the lowest part of the crankcase and therefore not subjected to air locks. The oil is conveyed under pressure from this pump to all working parts of the engine, including the three journals on the crankshaft, crank pin, eccentric and crosshead guides, this latter being a new development in engine lubrication.

The crossheads are made of steel, casehardened and ground, with about 3/1000 of an inch clearance in a ground cylindrical crosshead guide. At the point of mid-stroke oil is introduced through the crosshead guide on to the working face of the crosshead, and as the length of the crosshead is in excess of the length of the stroke it follows that the hole supplying



Vertical section of engine through crankshaft axis



Clarkson water tube boiler

the lubricant is at no time uncovered by the crosshead.

By suitable channelling in the face of the crosshead and holes leading therefrom to the crosshead pin, this also is placed in communication with the oil pressure feed—an arrangement that has been found to work most satisfactorily.

Piston valves are used on the high pressure cylinders, and flat valves on the low pressure. The operation of all the valves on both lines of cylinders is provided by a single eccentric.

The engine is mounted on the chassis frame in a unique manner, providing for flexibility and stability. One of the illustrations shows how the engine is connected to the frame by two extending arms which terminate in bearings, these bearings embracing trunnions which are securely bolted to the side members of the frame.

At the rear of the engine a cross member of the frame carries a pin which fits into a hole on the pump case of the engine. The engine is thus carried upon three cylindrical supports and it is free to slide upon them. There is no unnecessary constraint imposed upon the engine, and it has a wide basis of support to resist the torque and to carry the weight of the engine direct to the frame without the employment of a sub-frame.

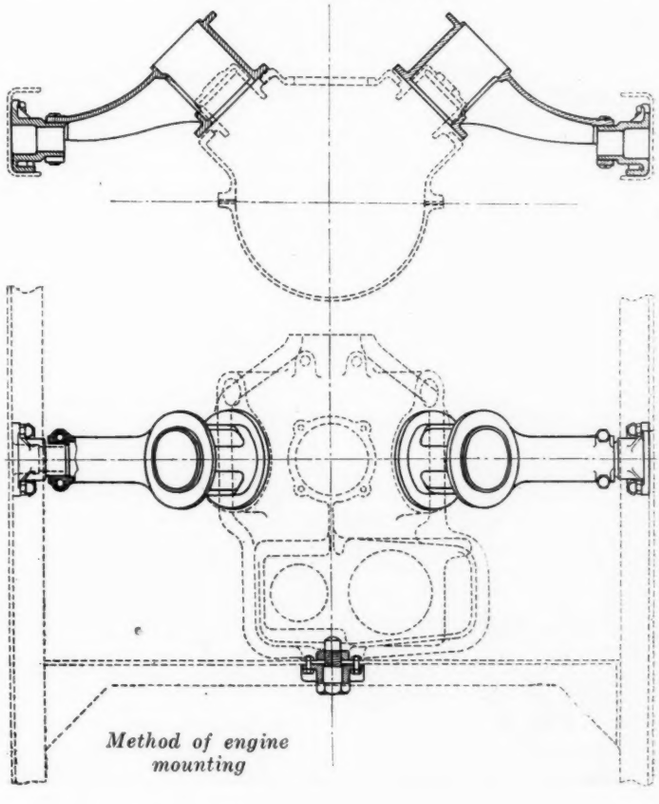
Condenser

The condenser is situated in the place usually occupied by the radiator and consists of a top and bottom header united by radiating tubes. As trouble has been experienced in the past in keeping the condenser tight under conditions of road vibration, and the strains introduced with the expansion of the radiating tubes due to the passage of steam through them, an improvement has been made in this condenser by allowing the lower tube plate to move up and down within suitable guides as may be necessitated by changes of temperature in the radiating tubes. The lower header is actually hung upon the tubes and is kept in position within the guides by four short, stiff springs.

The back of the condenser is shrouded and furnished with a powerful fan for ventilation. The fan is driven by a belt from a short lay-shaft running along the side of the chassis from the engine.

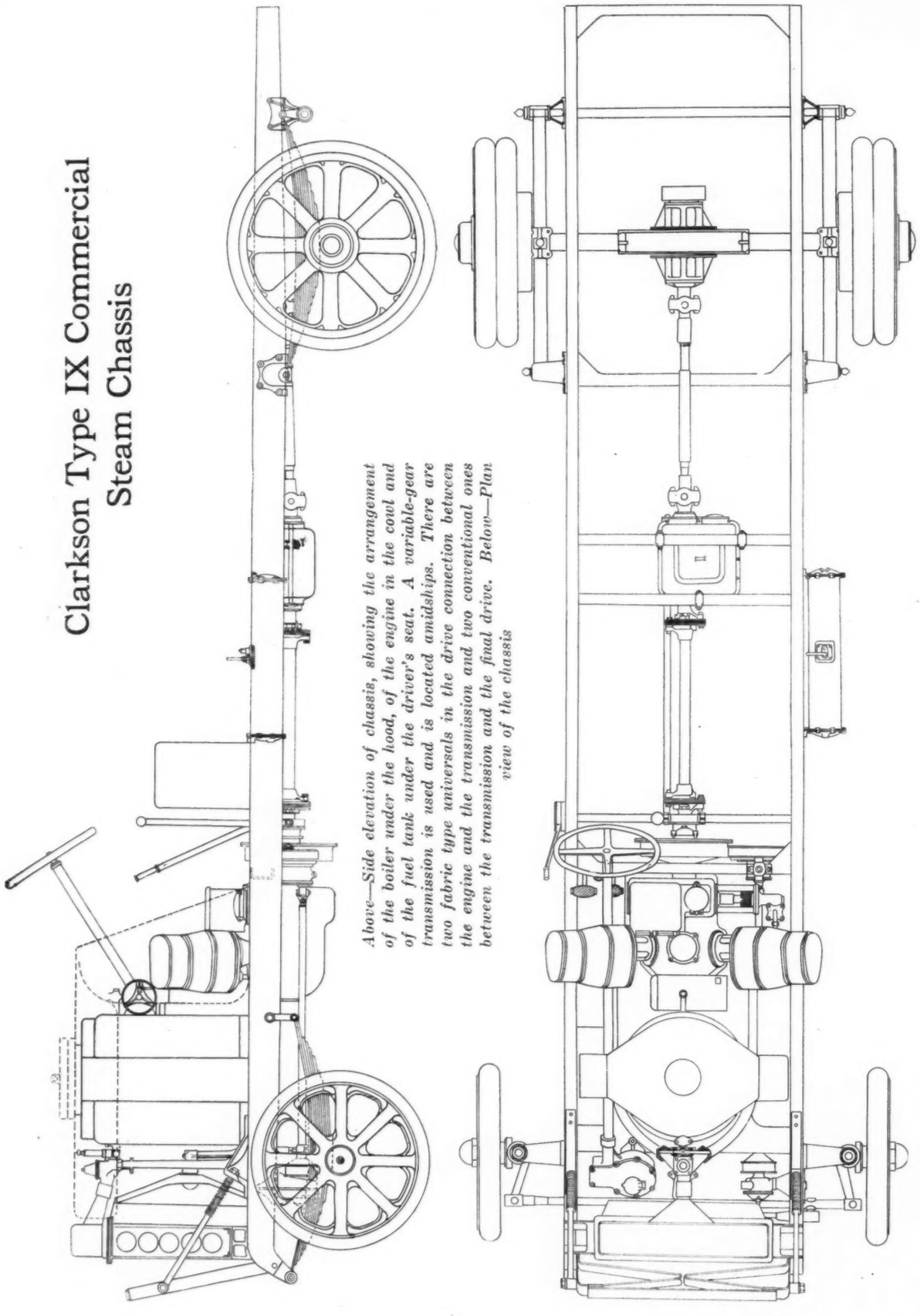
At the forward end of the lay-shaft is provided a rotary pump which drains the lower header of the condenser and

(*Continued on page* 946)



Method of engine mounting

Clarkson Type IX Commercial Steam Chassis



Above—Side elevation of chassis, showing the arrangement of the boiler under the hood, of the engine in the cowl and of the fuel tank under the driver's seat. A variable-gear transmission is used and is located amidships. There are two fabric type universals in the drive connection between the engine and the transmission and two conventional ones between the transmission and the final drive. Below—Plan view of the chassis

Cultivating Japanese Automobile Field

PART II

A Study of Business Methods—How to Make Selling Connections—Considering Distributing Centers—The Arrangement of Selling Prices—Repair Facilities

By Tom O. Jones
Special Agent of the Department of Commerce

JAPANESE business methods vary so greatly from those in America that they cannot be overlooked as forming a most important factor in the successful retail sale of motor cars.

Practically every large firm in Japan now selling motor vehicles is engaged in importing general merchandise. In some instances the motor business is conducted as a separate department; sometimes new corporations are formed and distinctive names assumed; but in either case the parent company is closely allied with the motor sales.

The foregoing arrangement works to the advantage of the automobile business, for the parent companies have extensive business connections throughout the country, and by far the greater number of cars disposed of in Japan are sold either on a basis of business relations in other lines or on friendship. The reader should bear in mind that there are less than 3000 cars in Japan and the purchase of a vehicle by an influential citizen is known almost immediately by every dealer and every importer.

Friendship without business influence may work for or against the dealer. One representative of a splendid line of American cars outlined the case as follows: "If a friend of mine wishes to buy a car, either of two thoughts run through his mind. One is that I will give him as good a car at as low a price as possible, because we are friendly; the other, that as we are friends, I will feel that he is obligated to buy from me, and therefore I will make the price higher rather than lower because of the friendship." The Japanese dealer requires more than the usual amount of diplomacy in handling his trade. Therefore, as in the United States or in any other part of the world, the financial standing and business connections of the dealer should have most important consideration by the American manufacturer in selecting an agent.

The established large houses generally have branches or representatives in every important city in the country. It is evident, therefore, that the ideal selling agent *for Japan is a large Japanese firm operating in general lines, with its connections already established, and having an organization that is in touch with conditions throughout the country.* Such firms are naturally somewhat limited in number and far too few to handle the numerous American cars, were they all to be represented in Japan. In case such a connection cannot be secured, an American firm that has an established reputation should be the choice. According to the manager of one house handling American cars, difficulty is experienced in subdealer selling, the idea being that the subdealer cannot make as low a price as the direct dealer.

Generally there seems no disposition on the part of the Japanese dealer to ask for any unusual financial arrangement. Most of the importers are wealthy firms with an abundance of capital to finance their business on a basis of cash in America against shipping documents. One or two American importing firms stated that they secure better terms on other lines of merchandise and would like to have similar accommodations from American manufacturers of motor vehicles. There is reason to believe that the manufacturers of higher-priced American cars may find it necessary to extend some credit by shipping on 60 or 90 day drafts, if they are to meet European competition after the war. Whether such action will be required on the part of the manufacturer of the lower-priced cars will depend entirely on the competition given by the European manufacturers.

ESTABLISHED Japanese general dealers make the best selling agents.

As a rule, no unusual arrangements for payment are necessary.

Garage equipment is good, and Japanese mechanics are generally efficient.

The setting of fixed selling prices in Japan is not recommended. The giving of commissions is a usual practice.

American manufacturers should stipulate that the distributer maintains branches or dealer connections in principal cities.

Tokyo is the capital, and also the motoring center, having almost one-half of the cars now operating in Japan. The city has several attractive automobile showrooms and efficient repair-shops.

Selling Connections for American Manufacturers

An established firm in Tokyo that has branches or representatives in other important cities can secure all the motor-vehicle business available. No company hoping for maximum business should for a moment consider a firm that does not have its home office or a strong branch in the capital.

One or two companies have tried intensified selling in Japan by having one direct dealer in Tokyo for the eastern section and another direct dealer in Osaka or Kobe for the western section. The one American company operating under this plan at the present time is ex-

periencing difficulties. Its representative in Tokyo is an American house and in Osaka a Japanese house. The American dealers in the capital complain continually that their territory is being infringed upon. The American manufacturer, through his traveling agents, has gone to great pains to investigate many of these complaints and in practically all cases it was found that cars of this make which have come into the eastern territory have been purchased in America and shipped to or by the individual owners. There has been much correspondence, and even with reports from the manufacturer, the Tokyo dealer still feels that some cars are coming into his territory through the other representative, a condition which is not conducive to an enthusiastic promotion of the line.

Within the past few years there has been a great improvement in automobile salesrooms in Japan. Many of the dealers, even the large ones, still confine the display of cars to the garage, but new buildings erected within the last two years or in construction at the present time have showroom facilities that afford window displays on the streets. Generally these rooms are similar to those found in America, but it is seldom that there is more than enough room for the display of two cars on the salesroom floor, although three or four cars are often crowded in.

Facilities for Repair Work

Garage equipment in Japan compares favorably with that of the American garage. This is a matter of necessity. A dealer called upon to replace a part that is missing from his stock would require at least six weeks to obtain it from America, even if the part were cabled for. Obviously, it is not good business for him to deprive his customer of the use of the car for six weeks or more, and therefore he finds it necessary to manufacture the part, and for this purpose he must have a fair machine-shop equipment.

Japanese mechanics generally are efficient in their work and when required to make a motor part can copy it quickly and satisfactorily, so that if it will not do permanent duty, it will at least permit the car to be operated until replacements can be secured from America. This must not be taken to mean that Japanese dealers are not disposed to carry parts, for they usually have a good supply, but delays of various kinds may deplete their stocks. In fact, when taking an agency one of their first questions is in regard to what arrangements the American company will make to supply them with parts. Certainly no manufacturer should allow his cars to go into Japan without a plentiful supply of spare parts. While consignment of these parts may be requested, the usual cash basis will not be a very serious obstacle.

While the mechanics learn quickly, the weak point of Japanese organizations is in electrical equipment and finer motor adjustments, but on the whole cars are kept in fair condition by the native garages.

Selling on Fixed-Price Basis

The giving of commissions or presents to parties assisting in influencing sales is one that the dealer should consider from every angle. It is one of the older business practices that has crept into the sale of motor cars. In the sale of automobiles the chauffeur is often the intermediary who profits to the extent of $50 to $100, handed to him by the dealer when the deal is consummated.

The manager of a company selling one of the low-priced cars in Japan states that many times his company failed to come within three or four parties of the person actually buying the car. By this he meant that a man about to buy his first car might announce the fact to the steward of his household, who in turn would go to a broker who did business with the motor-car dealer. If it happened that the purchaser lived in some small town and the buying was done from the city dealer, there would be another intermediary.

Under such a system, with constantly varying freight rates, it is difficult to set fixed prices on cars in Japan, and the American manufacturer who insists that the selling be limited to a certain percentage above the landed cost of the cars is imposing a condition which will place a hardship on his representative. Low price alone will not assure the sale of a certain car as against another car of similar type. The commission given to the chauffeur is for his good will and, in the estimation of the Japanese dealer, this is of greater value than a difference in price of equal amount. The dealers claim that practically no Japanese buyer will purchase without the sanction of his chauffeur, and many of them would hesitate to force a sale against the opposition of the chauffeur, because the driver is in position to do them a certain amount of harm by the exploitation of fancied faults in the car.

One dealer interviewed said that he has endeavored to do business on a fixed-price basis and that he refuses commissions to chauffeurs. Taking his word for this, it is a fact that with his line of cars, consisting of three noncompeting types with a wide range in price, he is not getting the business that he should on any one of them. He admits that he is unpopular with chauffeurs, and therein may lie the reason.

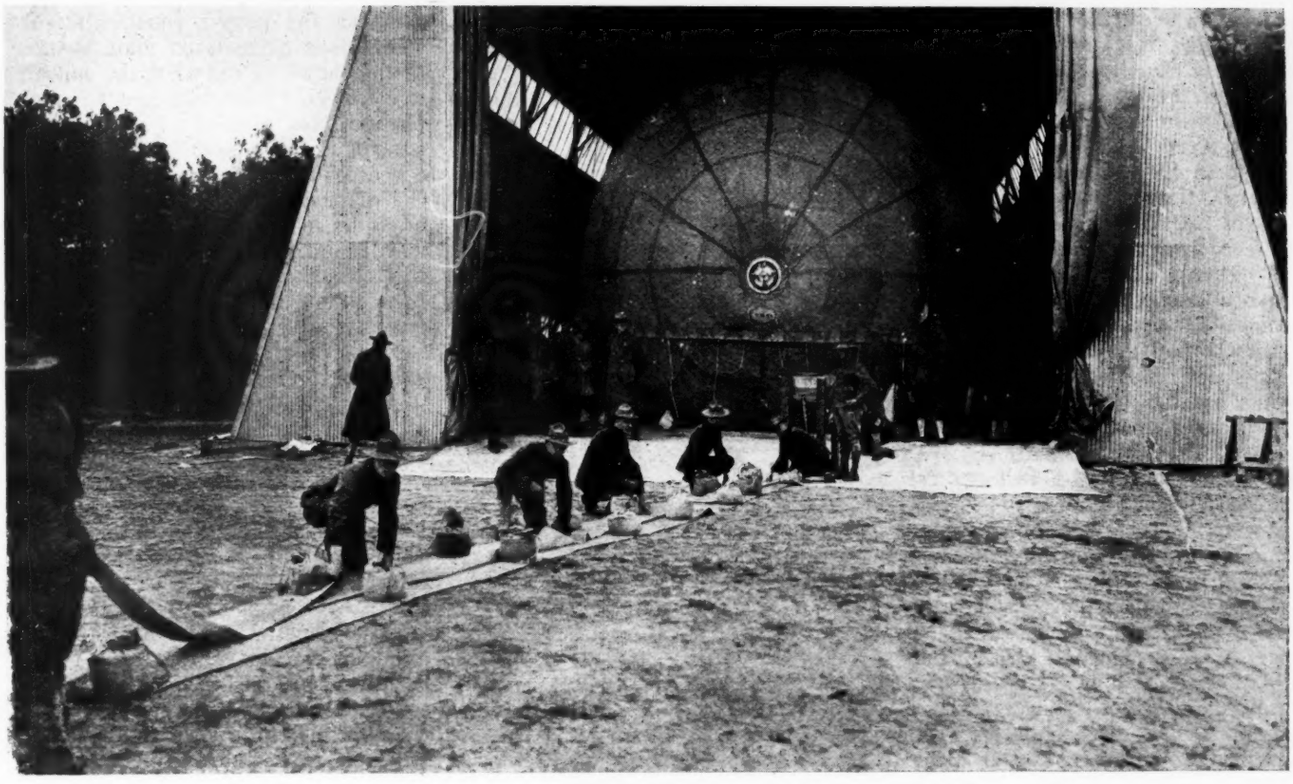
European car owners generally recognize this established way of doing business. When one of them remarked one afternoon that he had purchased two new tires, he was asked if he had bought them himself. He said that he had simply sent his chauffeur after them. "I know that he made money on the deal," he added, "but I am perfectly satisfied. He probably bought them as cheaply as I could in any case, and making this extra money adds to his salary and keeps him satisfied. It does not amount to a great deal to me and I get better service and the car gets better attention."

Distributing Centers

In making a selling connection in Japan, the American manufacturer who concludes a contract with a Tokyo house should stipulate that branches be maintained or dealer connections of some kind established in Yokohama, Osaka, Kobe, Shiminoseki or Moji, and Nagoya. The relative importance of these largest cities in the motor-car trade is best revealed by the number of cars in operation in each and the character of the districts of which they are trade centers.

Tokyo is the capital and the motoring center. Here are found nearly half the cars now in operation in Japan. Late in August of 1917 license number 1000 was issued in Tokyo, but without doubt there were 100 to 200 other cars in the city that were not registered. The fiscal year for automobile taxation begins on October 1 and cars are operated during the last two or three months of the fiscal year either on a special permit and without a formal license, or use of the old license is permitted on a new car until the end of the year. With additional shipments since August, 1917, the number of cars now in operation in Tokyo can safely be placed at 1400. The city has several attractive automobile showrooms. The dealers' facilities for making repairs and adjustments are good, and a staff of Japanese mechanics and machine-shop equipment is maintained in connection with each of the large garages. Nearly all carry a fair selection of repair parts.

(*To be continued*)



A war balloon in its hangar

Manufacture of War Balloons in U. S.*

Observation Balloons Used by American Army an Adaptation of the French Caquot Type—Made by the Large Tire Manufacturers—Industry Developed Rapidly

By Allen Sinsheimer

SIXTEEN months ago there was no war balloon industry in the United States. To-day war balloons, made in this country, in sufficient quantities and efficiently equipped and manned, form an important part of the American Expeditionary Forces in France. They are huge contrivances, non-rigid, and use hydrogen gas for sustentation. Highly trained observers operate them. Army offensives frequently depend for their success upon their observations.

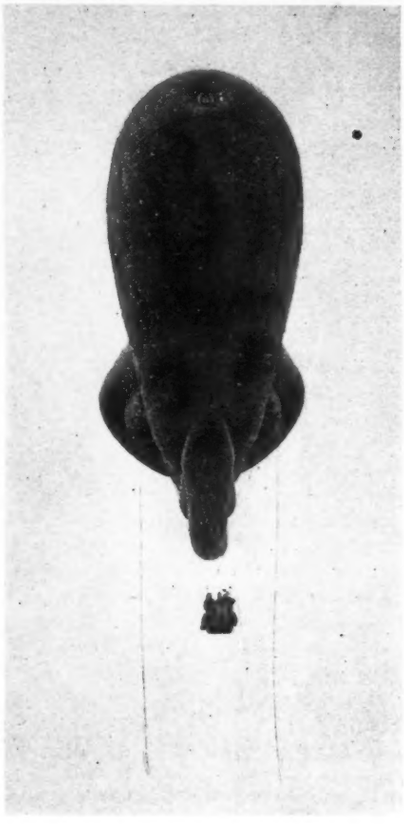
The United States Government upon entering the war commenced production by working on a sample balloon from the front. Duplication of the foreign-made article was difficult, especially as quantity production was necessary. Balloon fabric manufacture was new in the United States and the material was scarce. It was found necessary to bring over from France a number of experienced men and women to work with the Americans as instructors. Production was speeded up, and through cooperation of the mills looms were secured and the manufacture of the cloth in quantity was started. In addition to an efficient labor organization it was necessary to have balloon factories especially constructed with free and open floor space and a complete absence of dust and dirt. These were obtained by sacrificing other lines of business, the tire manufacturers aiding considerably and taking on much of this work. All this required time, but when the balloon schools in this country opened and called for balloons their requirements were met immediately. To-day the United States has not only equipped its own army, but in addition is helping to supply the Allies as well. Equipping an army with balloons means more than the original supply. It includes also the replenishment supplies to keep pace with losses by fire, accidents, enemy airplanes and artillery.

In commencing balloon manufacture the Government revived a dead industry; in fact, it practically created a new industry. The spherical balloons, a few of which had been made in this country for use at circuses, were of no value whatever. These were free balloons, while the army balloons are of a captive type, staked to the earth and shaped like huge legless elephants, from which they take their name.

The American army balloon is an adaptation from the French Caquot type. Some years ago Germany developed a fairly satisfactory but somewhat treacherous bal-

*This article, by our Washington correspondent, was written before the armistice was signed.—Editor.

loon known as the Drachen type. France and England conducted experiments, but made nothing superior to the Drachen. In 1916, at the Mexican border, the United States Army had but one captive balloon, a gift to a national guard battery. So at the beginning of the present war there were no satisfactory observation balloons, and even the German Drachens, unable to reach a height beyond anti-aircraft gunnery, were useless. At this point Captain Caquot of the French Army developed the Caquot type, which has stood the test of the last two years of the war and which has been copied by the Germans. All the Allied observation balloons followed the construction of Caquot. They are non-rigid and designed to remain steady in varying winds and to reach a satisfactory altitude for necessary observations. The gas bag is larger in diameter at the nose, or forward end, which heads into the wind, than at the tail. It is approximately 93 ft. long, with a maximum diameter of 28 ft. Its capacity for hydrogen gas is 35,000 cu. ft. At the tail of the balloon is the "rudder," created of lobes, which steadies it and prevents rocking and pitching.



View of balloon from below

The lobes forming the rudder are filled with air by the wind alone, the internal pressure depending entirely on the velocity of the wind at different altitudes and on weather conditions.

A diaphragm extends from the nose to a point close to the tail on the lower side of the balloon. This diaphragm, made of rubberized fabric, the same as the entire envelope, has a capacity for 10,000 cu. ft. of air. Wind inlets are so arranged that as the amount of hydrogen gas in the balloon proper decreases, either through cold or by leakage, the balloonette fills with air and thus keeps the shape of the balloon intact. This is important, as the proper functioning of the balloon depends on maintenance of the shape. Thus when the balloon is completely filled with gas, the diaphragm lays parallel with the lower part of the envelope, but as the gas decreases and the air enters between the diaphragm and the lower lining of the envelope the diaphragm rises, and if sufficient air is taken in to fill the capacity of 10,000 cu. ft., it forms the balloonette inside of the balloon.

The life of a balloon is from 1 hour to 7 months, depending on weather conditions and the accuracy of enemy airplanes and anti-balloon gunners. In camps in this country the average effective life of a balloon is 5 months.

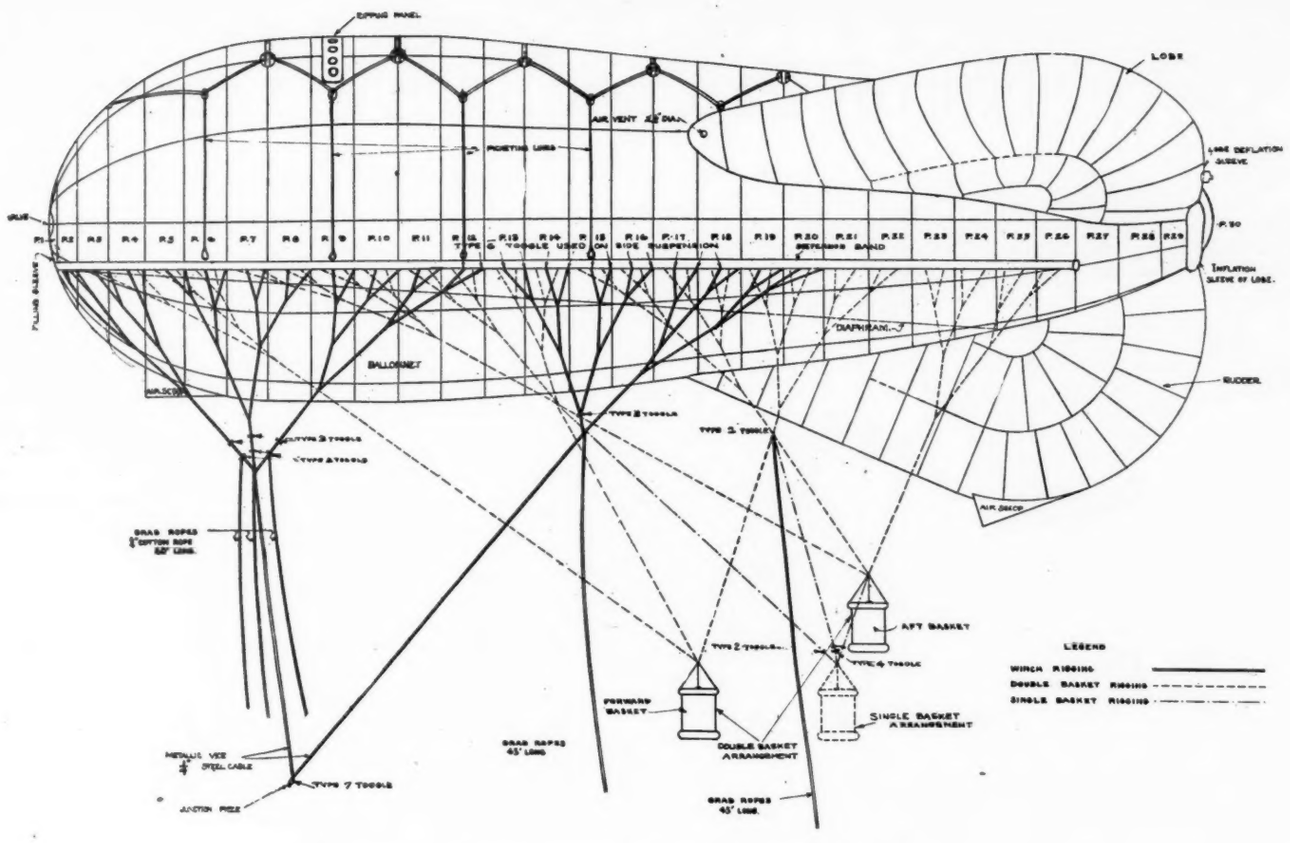
Communication between the observers in the balloon basket and artillery officers on the ground is maintained by telephone. The telephone wire is sometimes a separate cable, although the latest apparatus is so designed that the telephone wire is contained in the center of the main cable connecting with the balloon, which is a specially stranded ¼-in. steel cable.

The windlass controlling the balloon, together with the cable, is mounted on a truck which can travel even while the balloon is in the air. This is an adaptation of a French invention now manufactured by American companies. Observers in the balloon baskets, which are suspended from the balloon by means of special rigging, are equipped with parachutes for use in emergencies, such as explosion of or firing of the balloon by the enemy.

Many other accessories had to be developed for the balloon service. The production of hydrogen was a problem involving much consideration. The equipment, including the field generators and main supply stations, containers for shipping and storage purposes, methods of

Gas bottles used in inflating balloons

Observers in the basket, with parachutes on outside



Drawing showing construction of balloon and its rigging

transferring the gas from the containers for shipping and storage and from the containers to the balloons, all required individual attention. Each problem has been worked out successfully, and the balloon service is said to be operated so as to meet the full requirements of the army.

—

Weight of Internal Combustion Engines

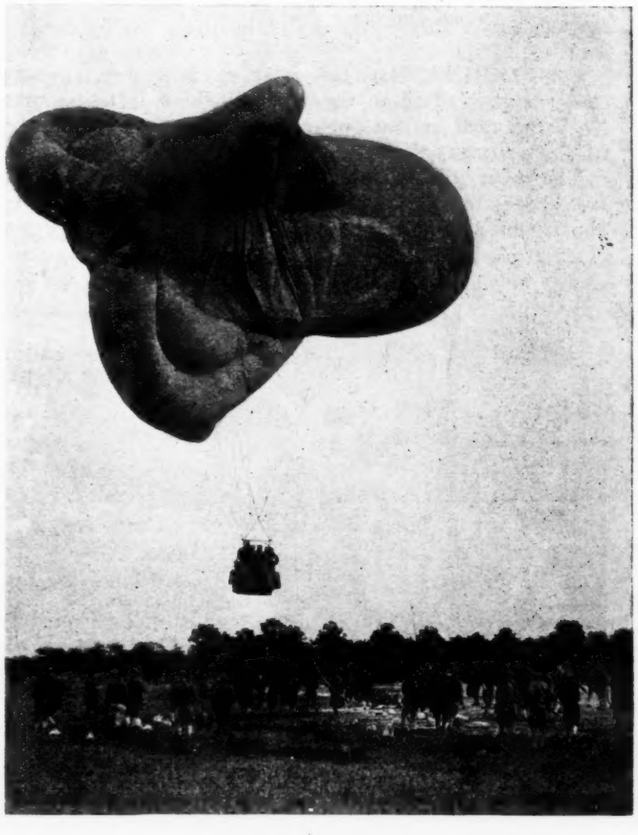
A CORRESPONDENT of *Engineering* discusses the relative weight of aero and submarine engines and the way in which weights of engines vary with linear dimensions.

Consider any given aero engine weighing, say, 3 lb. per brake horsepower, and also an exact model of this engine made to half the scale of the original. A little reflection will show that this model would possess the following properties:

1. It would weigh one-eighth of the original.
2. It would have the same air speeds, bearing pressures, bearing speeds and stresses (including inertia stresses) if run at the same piston speed as the original (*i.e.*, at double the revolutions) and on the same pressure cycle.
3. If it were worked on the same pressure cycle as the original it would develop one-quarter of the power of the original at the same piston speed.
4. Its weight per brake horsepower under the conditions of 2 and 3 would be one-half that of the original; that is, 1.5 lb. per brake horsepower.

Now an average submarine engine cylinder has a bore and stroke roughly three times that of an average aero engine cylinder, so the latter has a 3:1 advantage on dimensional considerations only.

Accepting the figure 10 for the ratio of weight per brake horsepower of Diesel engine to weight per brake horsepower of aero engine, there remains a ratio of 3 1-3:1 to be accounted for by reduced m.e.p. in large engines, additional metal serving as heat ducts, use of cheaper metals of low strength value, and low piston speed.



Balloon in ascent

Port Huron Friction Drive Tractor

Disk Drive Combined With a System of Spur Gearing—Two-Piece Bull Gear Used

The Port Huron tractor. It is designed for three 14-in. plows and has a drawbar pull of 12 hp.

A COMBINATION of friction disk and spur-gear drive is used in the tractor which is being manufactured by the Port Huron Engine & Thresher Co. of Port Huron, Mich.

The reversible, variable friction-drive system comprises two metal driven disks, mounted on a horizontal cross shaft, which are brought into contact, one for the forward and the other for the reverse movement of the tractor, by means of a lever, with a fiber wheel which is bolted to the crankshaft of the motor. The cross shaft also carries at one end a belt pulley and at the other the main pinion, which transmits the power to the intermediate spur gears connecting with the gears on the driving axle.

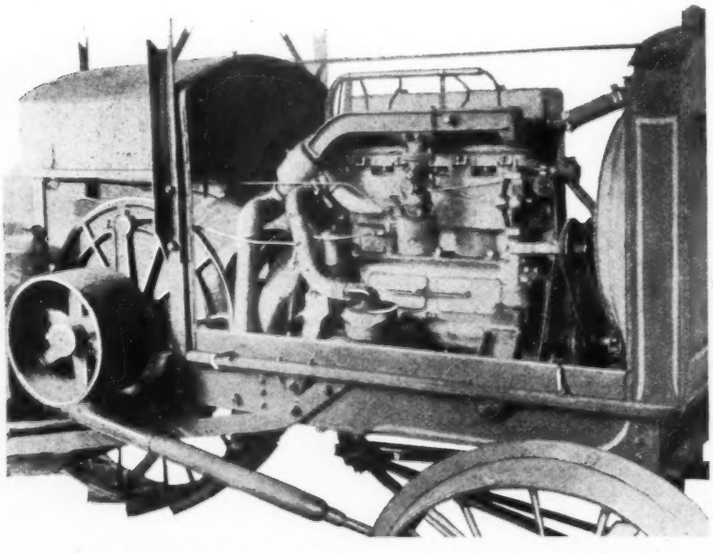
With the exception of the differential gears and pinions, all of the transmission gears are machine cut. They are enclosed in a dustproof casing and run in a bath of oil. The larger gears are made of semi-steel. The bevel gears in the differential and the pinion are of open-hearth cast steel, as are also the bull pinions, intermediate pinion and main pinion, all of which are machine cut.

In the construction of the bull gears the hub and spokes are made in one piece, and the rim and gear teeth in another. As a result, when the gear becomes worn it is necessary merely to renew the rim, which can be done by removing six bolts.

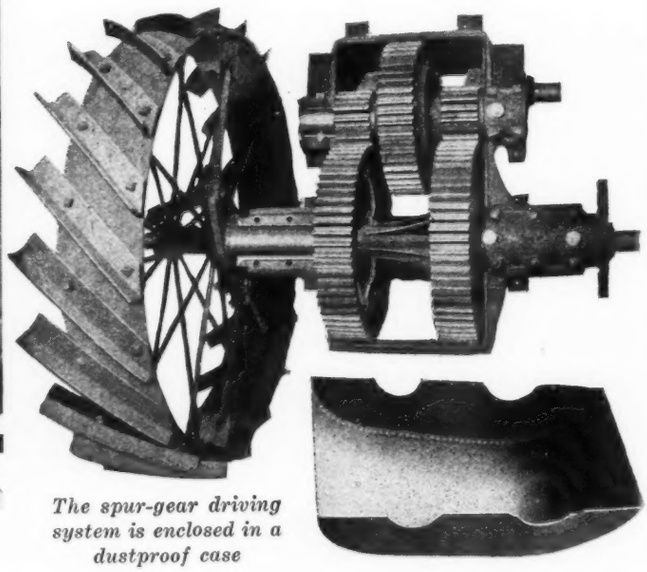
The engine has a rating of 12-25 hp., and is an Erd of the kerosene-burning type, having four cylinders with a bore of 4 in. and a stroke of 6 in. The valves are located in the cylinder heads. The engine is throttle governed by means of a fly-ball governor, and has a normal speed of 900 r.p.m.

Lubrication is effected by means of a double-filtered splash system with circulating pump. A Kingston mag-

(*Continued on page* 946)



The engine and part of the friction disk transmission of the Port Huron tractor



The spur-gear driving system is enclosed in a dustproof case

The FORUM

Constant Compression Engines

By C. K. Salisbury

ONE type of engine especially well adapted for automobile use has received practically no consideration from automobile engineers, mainly because of the extreme difficulty in carrying out any practical design. This is the adjustable combustion chamber type.

Late developments indicate that the main difficulties of design may be quite easily overcome, and as a close investigation shows very high possible thermal efficiencies on partial charges (which would make it desirable for automobile use), a careful study of the efficiencies will be made.

The distinctive characteristic of this engine is that the compression of a partial charge is the same as that applied to a full charge by proportionately reducing the volume of the combustion chamber. With proper form of combustion chamber it is possible to reduce the area of chamber wall exposed to the burning fuel almost directly as the volume of charge is reduced, over a considerable range of charge variation. The explosive pressures developed by partial charges would consequently be as high as those developed by full charges for the same compression. The effect of this is that the thermal efficiency of a partial charge would be the same as for a full charge, provided the expansion was carried only to the same pressure above atmospheric as the exhaust pressure of the full charge. Under these conditions the efficiency line would remain horizontal. As the partial charge is always expanded to a lower pressure than the full charge in this type of engine, the partial charge will show higher efficiency.

Gain Due to Extra Expansion

The area added to the card by the extension of the expansion line for any partial charge over the area of the same charge expanded only to the exhaust pressure of a full charge is shown by the curve *G-H*. This curve gives readings directly proportional to the value of the charge and to the efficiency of the engine exploding full charges.

There are limitations as to the point that it is advisable to carry the reduction of the combustion chamber from the standpoint of efficiency. It is not desirable that the expansion line fall below the atmospheric line, as that would reduce the efficiency. This must be balanced against the effect on lighter charges where the combustion chamber volume would not be varied to correspond to the charge reduction. A greatly increased ratio of chamber wall area to chamber volume will also tend to greatly reduce the efficiency. This can be offset by increasing the compression of small charges, even at low speed, above that for full charges, because of the small crank angle at which the compression reaches a high value. Another thing that has a big effect in keeping up the efficiency of small charges is their high rate of expansion. This is almost twice as rapid for the one-quarter charge as for the full charge.

The diagram shows the effect of a reduction of combustion chamber volume to one-quarter of full-charge volume.

The present type of automobile engine loses efficiency quite rapidly when the charge is reduced. The curve

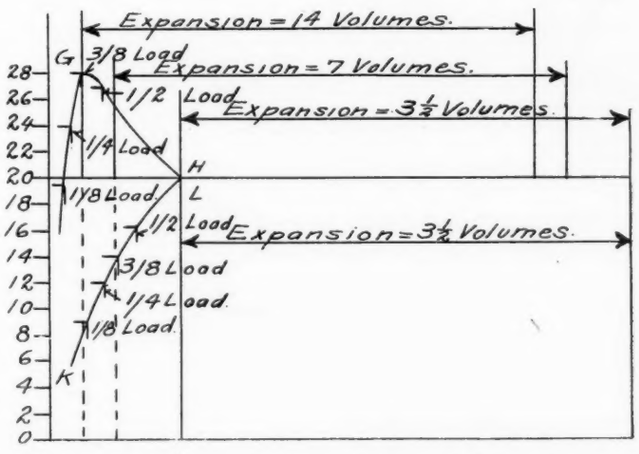


Diagram showing variation of thermal efficiency with load in engines with constant compression (upper curve) and variable compression (lower curve) respectively

K-L directly indicates the thermal efficiency for various charges.

In making a direct comparison between the two types the efficiencies are based on similar engine loads at a fixed engine speed.

The automobile engine of good design is of about 20 per cent thermal efficiency at full load, which will be taken as full load efficiency of the types compared.

At one-half load the regular engine shows an efficiency of about 16 per cent, while the adjustable chamber type would give about 27 per cent. At three-eighths load the regular engine shows about 14 per cent efficiency, while the other type would show about 28 per cent. At one-quarter load the regular engine shows about 12 per cent efficiency, while the other type would show about 24 per cent. At one-eighth load the regular type shows about 9 per cent, while the adjustable type would show about 20 per cent.

If correctly designed, the thermal efficiencies will be fully twice that of the present type over the power ranges commonly used in automobile work.

Compression May Be Regulated

One very important point in favor of the type is that the compression of the charge may be regulated to obtain best results according to the engine speed. As the automobile engine should have a comparatively low compression for starting and for low speed, considerable increase of compression may be employed at higher speed with consequent increase in thermal efficiency, but with very little increase in engine weight.

The very important feature of this type is that the efficiency is the highest at partial loads. This permits of employing high-powered engines with high efficiency at normal operating loads. An engine having its efficiency highest at full load means either an underpowered engine or inefficient operation.

As pointed out by AUTOMOTIVE INDUSTRIES, the engine of higher thermal efficiency will materially aid in solving the problem of using kerosene. This, taken with the gasoline situation, warrants most careful consideration of the type.

AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

PUBLISHED WEEKLY

Vol. XXXIX Thursday, November 28, 1918 No. 22

THE CLASS JOURNAL COMPANY
Horace M. Swetland, President
W. I. Ralph, Vice-President E. M. Corey, Treasurer
A. B. Swetland, General Manager
U. P. C. Building, 231-241 West 39th Street, New York City

BUSINESS DEPARTMENT
Harry Tipper, Manager

EDITORIAL
David Beecroft, Directing Editor
P. M. Heldt Sydney Oxberry
DETROIT OFFICE WASHINGTON OFFICE
J. Edward Schipper Allen Sinsheimer

BRANCH OFFICES
Chicago—Mallers Bldg., 59 East Madison St., Phone Randolph 6960
Detroit—95 Fort Street, West, Phone Main 1351
Cleveland— Guardian Bldg., Phone Main 1142.

Cable Address - Autoland, New York
Long Distance Telephone - 8760 Bryant, New York

SUBSCRIPTION RATES
United States and Mexico - One Year, $3.00
Canada - One Year, 5.00
Foreign Countries - One Year, 6.00

To Subscribers—Do not send money by ordinary mail. Remit by Draft, Post-Office or Express Money Order or Register your letter.

HORSELESS AGE SUBSCRIBERS
Subscriptions for the Horseless Age transferred to the subscription list of AUTOMOTIVE INDUSTRIES in the merging of the two publications will be completed in full by the weekly issues of AUTOMOTIVE INDUSTRIES to the dates of expiration shown on the records of the Horseless Age Co.

Owned by United Publishers Corporation, Address 243 West 39th St., New York; H. M. Swetland, President; Charles G. Phillips, Vice-President; W. H. Taylor, Treasurer; A. C. Pearson, Secretary.

Entered as second-class matter Jan. 2, 1903, at the post-office at New York, New York, under the Act of March 3, 1879.

Member of the Audit Bureau of Circulations.

Automotive Industries-The Automobile is a consolidation of The Automobile (monthly) and the Motor Review (weekly), May, 1902, Dealer and Repairman (monthly), October, 1903, and the Automobile Magazine (monthly), July, 1907.

The Abandonment of National Shows

IT was undoubtedly a wise decision on the part of the National Automobile Chamber of Commerce not to hold any national shows this winter. The great problem for the manufacturers will be to get their production back to a peace-time basis as quickly and as economically as possible. For the time being distributing problems are of minor importance compared with production problems.

There has been as yet no great disorganization of automobile sales agencies. Except in the smaller centers, most of the dealers have kept going, despite the difficulty of getting cars to sell. It devolves upon the manufacturers to see that these dealers who "stuck" in times of stress shall from now on get all the cars they can dispose of. Where agencies have been broken up as a result of the draft or because they could get no cars, the gaps will be filled again in the course of the year as our soldiers return from abroad and as industries that have been devoted to munitions and similar war work are shut down.

If it had been decided to go ahead with the shows, in view of the short time available we could not have expected much new and novel in the exhibits. Since the entrance of the United States into the war and the gradual conversion of the automobile plants into war equipment factories, little development has been carried on in connection with passenger cars. It would have been impossible to start on new designs now and get exhibition models ready by January or, at the latest, February. And to exhibit the same models as at last year's shows would have hardly warranted the trouble and expense, as it might have resulted in a sense of disappointment on the part of visitors, inasmuch as the holding of an industrial show is always taken to imply the creation of new products.

For the present there is no need to stimulate the market by means of innovations in designs. The public has been unable to get nearly as many cars of the present type as it has wanted to buy, and it will readily continue to purchase these machines through the coming season. This will give the manufacturers plenty of time to develop their 1920 models. In these we may expect to see improvements of a more far-reaching nature than have been witnessed for some time, partly because of the engineering experience gained during the past two years and partly because of altered market conditions as a result of the war. Such radical changes in design demand an extended period of try-out, and if designs are started now there will be ample opportunity to submit the experimental models to rigid tests before starting production on them.

The Post-War Model

WHATEVER thoughts arise in the mind with reference to the post-war automobile, there is one which should be universal. The pre-war car is not good enough.

We have all had a chance to clean house during the war. Manufacturers generally, in shifting from commercial to war work, have been able largely to idealize their factories and methods because the commercial factor did not stand in the way. In getting back to a peace basis the same thought can apply.

The inaccessible, heavy, uneconomical cars of the past must go. The new product must embody the principles of transportation efficiency. Less weight-per-pound of load, higher torque-per-pound of engine weight, per unit of displacement and per cubic inch of underhood space must be incorporated in the newer cars.

It is true that the development of the last 10 years in automobile design and manufacture was all trending in this direction, but now we have the opportunity to start afresh. The engineer has the opportunity which he has been craving for years. He does not have to confine himself in his designs in order to meet the requirements of the material left over from the year before, nor does he have to keep

within the limits of design as laid down by the sales department, on account of a committed policy.

There will be a period during the next few months when the material situation will make it impossible to start production. That is the time that should be occupied by real engineering design. When the time arrives that the Government again releases for commercial use the stores of steel now held for war, we will be off to a fresh start.

Let us take all we knew before, add to it what we learned during the war in the production of airplanes and other highly accurate Government material and come out with cars which from a standpoint of design and workmanship will leave past models as far behind as democracy has left autocracy.

We can be sure that the designers of Europe have learned much and will profit by it.

Let us not remain behind.

Price Adjustment

LIKE every other industry that has been more or less upset by the war, the automobile industry is bound to meet with considerable difficulty in regaining its stability. Prices of automobiles have been greatly boosted, first by the rising prices of labor and material and then as a result of the action of the War Industries Board in curtailing the delivery of material to automobile manufacturers and thus artificially cutting down the supply of cars. Undoubtedly a readjustment in price will have to come, but whether it will be immediately or only after a considerable period and whether it will substantially equal the price increase since the outbreak of the war or be less drastic are questions which cannot be answered off-hand and concerning which there are wide differences of opinion.

It is tolerably certain that there will not be any appreciable reduction in material and labor cost for a considerable time to come. In the last analysis it all comes down to a matter of labor cost, because a very large percentage of the cost of raw materials is made up of the cost of labor used in producing them. The wages of labor, on the other hand, must of necessity bear some relation to the cost of foodstuffs and other necessities of life. As the supplies of all of these necessities have been depleted by the war and the prices of some of them are guaranteed by the Government for a definite period, their cost is bound to remain high and there is no immediate hope for a general decline toward a pre-war basis all along the line. Materials will remain high, the wages of labor will remain high, and in so far as the present prices of automobiles are based directly upon these two factors their maintenance for some time to come will be fully justified.

On the other hand, there is a likelihood that some of the later advances in price were based not on increased cost, but on the artificial disturbance of the relation between supply and demand. Price increases in passenger cars seemed to be warranted even by patriotic considerations, as the Government had declared that the passenger car was a non-essential in the winning of the war and that its production must be curtailed. There was some evidence that manufacturers were acting in accordance with the spirit of this ruling, for in one particular instance a manufacturer increased the price on his passenger model and at the same time lowered the price on his commercial model which had substantially the same specifications. It was therefore obvious that this price revision was not the result of increased manufacturing cost but of a desire to direct automobile production into channels of more importance to the Government.

Where price revisions have been made for such reasons it is only natural that they should be immediately canceled, now that the war is over. In this connection it must be remembered that owing to the unusual conditions in the automobile market during the past year the general price level has been considerably disturbed. That is, the prices asked for cars do not bear the close proportion to the cost of manufacture and the intrinsic value of the machines that we would expect in normal times. For this reason, too, the fact that some few makers have cut their prices is no sign that there will be an immediate general price reduction. In fact, the consensus of opinion in the industry is that conditions are not ripe for such a reduction.

—

ONE of the greatest problems of the reconstruction period will undoubtedly be the creation of a demand for airplanes for other than war purposes. This is a problem the solution of which dissolves largely upon the Government, for it was the Government that induced the abnormal growth of this industry and held it down to normal profits. To now turn the industry adrift and let it shift for itself as best it may would certainly not be fair. There has never been a commercial demand for airplanes and one cannot be created over night. But if the organizations are to be held together an outlet must be found quickly. The most promising field for the immediate future is in aerial mail services, and it is most encouraging to learn that fifty additional aerial mail lines are in contemplation.

Of course all orders for military airplanes need not necessarily cease with the ending of the war. We certainly have all the army machines we will need for some time, but the suggestion has been made that our coast defenses should be equipped with hydro-aeroplanes or flying boats and if this is considered essential by the responsible authorities, a considerable volume of business would result.

—

THERE is much talk, privately and officially, of possible "unemployment." It is idle gossip. This nation is short 4,000,000 immigrants from the last four years. It is short 4,000,000 soldiers and sailors taken for the Army and Navy. Immigration will not increase importantly with peace. Europe offers too much opportunity. The Army and Navy will keep 1,000,000 men for European and sea police duty. It will take six months to muster out the 3,000,000 other men. There will be no "unemployment" because of peace. Some shortage of labor will continue.

□ Latest News of the

General Price Cut Not Likely

Manufacturers Not Inclined to Follow G. M. Lead in Reduction—Adjustment Period Necessary First

DETROIT, Nov. 26—Manufacturers generally will not follow the lead of the General Motors Co. and others in cutting prices. In fact, some have already sent out letters to their dealers telling them not to look for a reduction in prices until July "unless the action of some concerns precipitates a price war," in which case, they have assured their dealers they will be protected.

It is pointed out that in general, where prices have been reduced, the reduction is more theoretical than real, as the reduction has been made from prices that never really went into effect because they were announced either rcently or when the dealers had no cars to sell.

There is no denying the fact, that as a whole, peace has caught the manufacturer, as well as the ordinary citizen, unawares. The executives have had their minds concentrated on the request of the Government to have their plants on 100 per cent war work by January 1. In the twinkling of an eye, the entire problem has reversed itself, and it is now necessary to get back to a 100 per cent peace basis as arpidly as possible.

In the face of this it is not thought possible that prices can begin to descend on any safe and sane basis until at least the latter part of the coming Spring. Materials are just as high in price as they have been, labor prices are still on the same level and the manufacturing organizations of most automobile and motor parts concerns are on a war basis as regards tools and fixtures.

Selling organizations throughout the country are disrupted, both as regards main dealers and sub-dealers. These will have to be re-established and while this can be carried out fairly rapidly in most cases, it will take time to arrange contracts and get matters lined up on a workable basis.

The manufacturer has been out of touch with the dealer, and the dealer has been out of touch with the manufacturer, and the result is that the dealer does not understand the factory situation. This has already evidenced itself by the letters which have poured in from all parts of the country showing that the ideas of the dealer in regard to what the factory can really do towards getting back on a pre-war basis are to say the least, very vague.

A question which is paramount in the minds of manufacturers now is, "What does the public really expect?" Former avenues of information, through dealer and sub-dealer organizations, have not been functioning as in the past, and the result is that the manufacturing intelligence department is not as well informed as usual. There is a vague belief in the minds of the public, which has manifested itself in many ways, particularly through the dealer letters, that there are post-war models all ready and waiting for them. This probably would have been the case if the war would have gone another twelve months, but it is not the case now.

There are several tentative cars drawn up on the boards of the manufacturers, but very few of them have gone beyond the outline stage. There has not been time, and the question of getting the plant on a 100 per cent war basis has been so much more pressing, that there has been no time to push engineering designs. Furthermore, the demands of the Government upon the automotive engineering brains of the country have been so heavy that there has not been any talent available.

In Europe, where manufacturers have had four years of war, the situation is different. There are many post war cars designed in Europe, if apparently authentic reports be true. But on the other side of the water the demobilization of industry will be far slower than in this country, because they are far more deeply into it. Furthermore, the departures from pre-war manufacturing methods in Europe have been far more radical.

Orders for materials are being placed very slowly. There is not going to be any overnight turn-over to peace work. It is going to take eight months at least to get back on a solid footing, and during this time all branches of the industry, engineering, sales, manufacturing and purchasing, have a large and delicate task on their hands. It would be a false move at the present time to attempt to educate the public to quick and drastic price reductions, because they cannot logically be followed through.

—

Few Changes in New Maxwell

NEW YORK, Nov. 27—The new Maxwell cars coming through show refinements in detail only, the chassis design remaining practically the same as before. There is no change in price. The gasoline tank has been moved to the rear, the top is Pantasote and the dashboard is mahogany finish. The Johnson carbureter is now furnished as standard equipment.

26 Cities Schedule Shows

Circuit of Local Exhibitions Arranged at Cleveland Meeting of Show Managers

Cleveland	Late March, early April
New York	Probably February
Chicago	Probably March
Philadelphia	March
Detroit	January
St. Louis	Second or third week March
Utica	March
Syracuse	March
Des Moines	Feb. 17-22
Newark, N. J.	Feb. 15-22
Brooklyn, N. Y	Cars ..... March 22-29
	Trucks ..... April 1-5
Indianapolis	Not decided
Trenton, N. J.	Third wek March
Boston	March
Pittsburgh	March
Kansas City	Not dcided
Louisville	Feb. 15-22
Milwaukee	January or February
San Francisco	March 1-10
Minneapolis	Not decided
Harrisburg	Not decided
Buffalo	First week March
South Bethlehem	Cars ..... Feb. 17-22.
	Trucks ..... Feb. 24-27
Bridgeport	Not decided
Hartford	Not decided
Fort Dodge	Depends on building

CLEVELAND, Nov. 25—Local dealer shows will be held in 26 cities between January and April, 1919. A definite program of exhibitions was adopted today at a meeting of the National Association of Show Managers in convention at the Hollenden. Many of the dates are tentative, and in several cases the time when the show will be held depends upon the ability to obtain a suitable building.

When the National Automobile Chamber of Commerce last week voted not to hold the national events in New York and Chicago, the dealers all over the country immediately got busy. Plans were set afoot for bigger and better local exhibitions than have been held in previous years and in consequence such exhibitions are to be staged by dealer associations in 26 of the largest cities.

Definite arrangements have not yet been completed for the New York or Chicago shows. The New York dealers plan to stage their exhibition in Madison Square Garden probably in March. Chicago is figuring on the Coliseum, the Municipal Pier or the Siegel-Cooper Building. Minneapolis, which last year put on a truly automotive exhibition, which was bigger than the national shows in New York and Chicago together, will repeat the affair. Several cities have split their show programs into two periods, one for passenger cars and the other for trucks.

Automotive Industries

Substitute for Gasoline Tested by Bureau of Standards

Said to Be More Powerful Than Gasoline, Available in Ample Quantities and Entirely Satisfactory—Invention of Army Officer to Be Known As Liberty Fuel

WASHINGTON, Nov. 26—The Bureau of Standards has recently completed a series of tests of a substitute for gasoline which is said to be satisfactory in every respect, to cost less than gasoline, to be available in ample quantities and to give more power than gasoline.

The fuel is the result of experiments of Capt. E. C. Weisgerber, and the formula is a secret. A deal has been completed to commercialize the product and place it on the market.

Manufactured by Still Process

AUTOMOTIVE INDUSTRIES, making this announcement exclusively this week, can state further that the substitute is in liquid form manufactured by a still process, composed of commodities which are now a drug on the market and which are plentiful enough to assure supplies to meet the future demands. The formula is a secret in the hands of the General Engineering Depot and the inventor. The cost of manufacture is said to be 40 per cent lower than that of making gasoline.

The substitute, which is known as Liberty fuel, is the direct result of experiments by Capt. E. C. Weisgerber, an oil and gas engineer, who was first connected with the Engineering Corps and has lately been working at the Bureau of Standards. He was ordered to conduct the experiments by his commanding officer for the purpose of securing a fuel other than gasoline and more powerful and economical if possible.

Inventor an Army Officer

The substitute is described as scentless, tasteless and without gasification scent. It is said that its products of combustion are cooler than gasoline. It is reported to be non-corrosive. It does not give out soot or carbon, according to the reports, and starts easier than gasoline.

The quality and specific gravity are changeable at will, it is stated, and the substitute shows no ill effect on the lubricating oil. It will ignite only from spark or flame. No special apparatus is required either in the engine or carbureter or in the manufacture of the fuel.

Tests were held at the Naval Air Station and at Anacostia Flying Field, D. C., in comparison with special "X" quality of gasoline in which the water used with the Liberty fuel remained below 160 deg. Fahr. and the oil below 130 deg. Fahr.

In the tests by Army officers, mainly conducted by Captain Weisgerber, the new fuel was used in a passenger car, motorcycle, airplane, tractor and truck in comparison with gasoline. In the tests by the Bureau of Standards at the laboratories it was used in a Class B truck engine and a 150 hp. Hispano-Suiza airplane engine in comparison with gasoline.

Used on a passenger car the fuel drove the car 17½ miles to the gallon as against 9 m.p.g. on gasoline, and increased the speed from 47 m.p.h. to 69 m.p.h.

Tested in Hydroplane

In a hydroplane with the engine at 1600 r.p.m. the plane remained in the air 22 min. longer on 10 gal. of Liberty fuel than on 10 gal. of gasoline.

A Harley-Davidson motorcycle was driven 23,000 miles in severe tests and showed no corrosive action and no carbon. Weighing 593 lb. with its load the motorcycle journeyed 256 miles without adjustments on 4.66 gal. of Liberty fuel, consuming 1½ qt. lubricating oil, averaging 55 m.p.g. The average speed was 22.5 m.p.h. Used with gasoline over the same route and at the same speed the motorcycle averaged 32.18 m.p.g. and consumed 4 qt. of oil.

Increases Truck Mileage

A Garford 3-ton truck weighing 7373 lb. with its load averaged 10.4 m.p.g. with Liberty fuel over 232 miles, used 2 gal. of water in the radiator and consumed 2¼ qt. of lubricating oil, or 103.1 miles per quart. The journey was made at a speed from 9 to 12 m.p.h., the lower speed during rain. With gasoline the truck averaged 6.37 m.p.g., consuming 45 gal. of gasoline, used 8½ gal. of water in the radiator and 4½ qt. of lubricating oil at the rate of 63.5 miles per quart of oil. The truck easily traveled the Cumberland district mountains on high speed on Liberty fuel, and failed to do this with gasoline.

In a report of tests of the Liberty fuel by the Bureau of Standards signed by W. S. Stratton, chief of the bureau, on Nov. 21, it was stated that three grades of the fuel were submitted marked "type A," "type B" and "Liberty fuel," the first two being for passenger car and truck use and the third for airplane consumption.

The class B standardized truck engine and a 150 hp. Hispano-Suiza airplane engine were used by the Bureau of Standards in making tests. The truck tests were at one-half the maximum power and one-quarter the maximum power with readings taken in each run at a fixed load at 200 r.p.m. from 400 r.p.m. to 1200 r.p.m.

Commercial and special "X" gasoline were used in comparison. A Claudel carbureter was a part of the airplane engine. New spark plugs were used with each change of fuel. The airplane was operated under all conditions and with the throttle wide open.

Operation Completely Satisfactory

Summarizing in the report Dr. Stratton stated that there was no engine operation trouble, that the exhaust was clean, odorless and generally like gasoline, and that the Liberty fuel gave equal power, giving 3 per cent greater pounds consumed per brake horsepower and with consumption 5 per cent less than gasoline.

The summary further stated that the spark plugs showed slightly more carbon with Liberty fuel, and that the Liberty fuel showed 3 per cent greater horsepower when consuming 10 per cent greater weight of fuel per horsepower per hour though with the thermal efficiency of the engine 2 per cent greater as in contrast with special "X" airplane gasoline.

It was also stated that crystallization occurred at 14 deg. Fahr. and that the fuel could not be cooled much below this without danger of stoppage of fuel lines and the carbureter jet.

The differences between the criticisms above and the claims made by Captain Weisgerber were in the main cleared away. The crystallization, for example, it was agreed, could be eliminated by slight change in the quality of the Liberty fuel.

Following are exerpts of tests by the Bureau of Standards:

	Pounds of Fuel of U. S. Gals. at 60° Fahr.	Heat Value B. T. U. U. S. Gal.
Motor fuel type A.....	7.19	126,300
Motor fuel type B.....	7.20	127,900
Liberty fuel	7.07	124,800
Commercial G. S. C. 1918	6.33	119,200
Export airplane gasoline	5.93	113,000

Using motor fuel A versus gasoline in the B truck:

	R.P.M.	Beam, Lb.	B.H.P.	Consumption	
Gasoline	407	127.75	17.4	.131	with full load
"A" fuel	409	134.63	18.4	.128	
Gasoline	401	66.00	8.8	.166	with half load
"A" fuel	408	66.25	9.0	.141	
Gasoline	400	32.50	4.3	.191	with quarter load
"A" fuel	411	33.00	4.5	.176	

(*Continued on page* 945)

Ryan Out as Head of Aircraft

Secretary Baker Accepts Resignation but Sets No Date —No Successor

WASHINGTON, Nov. 22—John D. Ryan, Second Assistant Secretary of War in charge of Aircraft Production and Operation, has tendered his resignation. The resignation was accepted by Secretary of War Newton D. Baker, who has requested Mr. Ryan to set his own time for the relinquishment of his duties, and expresses the hope that Mr. Ryan will continue until demobilization and contract cancellation plans are matured.

John D. Ryan prior to assuming charge of aircraft was at the head of Red Cross work in Washington. He has been the president of the Anaconda Copper Co. and a prominent figure in the copper field since 1907. He was appointed to supervise the Bureau of Aircraft Production following the resignation of Howard E. Coffin as chairman of the Aircraft Production Board, and at a later date following the aircraft report by the Senate Military Affairs Committee, Secretary of War Baker appointed Mr. Ryan as Assistant Secretary of War in charge of all aircraft, including not only production but also operations.

Following is the correspondence between Mr. Ryan and Secretary Baker:

Nov. 21, 1918.

DEAR MR. SECRETARY:

With the signing of the Armistice and the consequent reduction in the program of Aircraft Production, I believe my work here has become relatively unimportant. I have not taken over the actual direction of Military Aeronautics and my connection with it has not made any real change in its operations.

I feel strongly that now the war is over, my duty lies in the line of my former work. Labor and industry of the country must be quickly adjusted from a war to a peace basis, and the copper production is one of the most vital of the country's welfare. I believe I can do much in helping to bring about stable conditions, and that I should take up the work immediately.

I therefore resign as Second Assistant Secretary of War and Director of Air Service, to take effect as soon as convenient to you.

I desire to express to you my sincere gratitude for the opportunity given me to serve in the war. I have had at your hands the greatest assistance and encouragement in all the work I have had to do. I shall always prize the association with you and with the War Department.

Sincerely yours,
(Signed) JOHN D. RYAN.

To the Secretary of War,
Washington, D. C.

JDR/ISD

Nov. 22, 1918.

MY DEAR MR. RYAN:

I have just received your letter of Nov. 21. Realizing the very great importance of the production and distribution of copper in the re-establishment of our national civilian industry, and your own intimate relation to this great business, I reluctantly acquiesce in your desire to return to it and to terminate your relations as Second Assistant Secretary of War and Director of Air Service.

Your unfailing courtesy has been a source of great personal happiness to me, and your services to the country as Director of Air Service have been conspicuous; the sense of sureness and executive efficiency which your advent contributed to the Air Service made from the first a marked improvement in the entire prospect. The armistice of course has interrupted the constructive development of that great program. It had, however, advanced beyond the experimental stages, and even in so new an art as the air service America's contribution within a year and a half was substantial and would, in a short time, have been determinative.

I shall set your own judgment as to the most appropriate time for the termination of your office, expressing only the hope that you will continue until the plans for contract cancellation and demobilization are sufficiently matured to allow those who are to carry them out to have definite and fixed principles for their guidance.

Cordially yours,
NEWTON D. BAKER,
Secretary of War.

Honorable John D. Ryan,
Second Assistant Secretary of War.

—

No New Director to Take Ryan's Place

WASHINGTON, Nov. 23—Following the announcement of the resignation of John D. Ryan it is said by the War Department that a new director will not be elected for the present to take his place. There is no longer a production problem to be handled and the airplane operation will now naturally become a military function probably to remain under Major General William Kenly, who is in charge of the Division of Military Aeronautics. It was stated that pending reorganization of the Army and the War Department on a peace basis, recommendations for which will be laid before Congress next month by Secretary Baker, it is not possible to arrange for the permanent aircraft establishment of the Army.

—

Five Training Fatalities

WASHINGTON, Nov. 20—For the week ending Nov. 9 there were five fatalities on the flying fields of the United States resulting from training in aviation. One fatality occurred at Dorr Field, Arcadia, Fla.; one at Ellington, Houston, Tex.; one at Langley, Hampton, Va.; one at Payne, West Point, Miss., and one at Wilbur Wright, Fairfield, Ohio. For each fatality reported a total of 4019 hours of flying, or 231,520 miles of air travel, is shown.

—

Continue Washington Naval Airplane Base

WASHINGTON, Nov. 22—The naval air station at Anacostia, D. C., will be made permanent and continued by the Navy as a testing field. Hangars have already been constructed, housing nine hydroplanes, and a personnel of 150 men is maintained.

—

Post Office Wants Anti-Freeze

WASHINGTON, Nov. 25—The Post Office Department, Office of the Purchasing Agent, has asked for bids as follows, f.o.b. factory, sealed proposals to be made prior to 2 p. m. Dec. 2:

Non-freezing solutions for use in motor truck radiators.
Quote on quantity sufficient for 25 cars.
Quote on quantity sufficient for 50 cars.
Quote on quantity sufficient for 100 cars.
Quote on quantity sufficient for 200 cars.

It is to be understood that samples are to be submitted, if requested by the department, prior to making the award.

Minerals in Burma Increase 16⅔%

Petroleum, Most Important, Only One to Decrease — 25% Increase Over 1915

WASHINGTON, Nov. 22—The Government of Burma, according to the American Consul there, increased its mineral product output in 1917 16½ per cent above that of 1916 and 25 per cent higher than in 1915. The figures for the 3 years are as follows:

Minerals	1915	1916	1917
Petroleum	$6,033,378	$5,357,534	$5,119,535
Tungsten ore	1,383,890	2,349,571	2,975,360
Lead	1,538,550	1,567,214	1,934,327
Silver	151,343	430,935	1,153,767
Tin and tin ore	207,142	316,435	461,389
Building material and road metal	320,036	319,554	347,627
Rubies, sapphires and spinels	176,646	172,557	252,236
Jade	61,695	45,330	140,794
Gold	60,028	37,517	20,672
Zinc ore	847	28,354	.....
Iron ore	20,147	20,869	6,151
Clay for pottery	651	3,163	3,997
Molybdenite	.....	445	3,715
Amber	970	766	3,329
Bismuth	.....	.....	795
Antimony ore	33	2,433	742
Platinum	484	226	93
Copper	11,515	.....	.....
Total	$9,967,355	$10,662,903	$12,424,529

The figures given in the table are said to represent the actual value of the product at the point of production.

The only mineral product of any consequence which showed a diminution in value of production was petroleum. The increase was most marked in silver, tungsten, tin and lead.

Petroleum is the most important mineral product of Burma, and petroleum production and refining is, next to the production and milling of rice, the most important industry of the Rangoon consular district. The value of the crude petroleum as stated in the above table gives little idea of the importance of this industry, for, of the products of the petroleum refineries—kerosene, gasoline, benzine, lubricating oil, paraffin, candles, etc.—after furnishing most of the needs of Burma, about $20,000,000 worth a year is exported to foreign countries and to other ports of India.

The principal oil fields of Burma are located in the Irrawaddy valley, about 200 to 400 miles from the sea. The most productive fields — Yenangyaung and Singu (Chauk) in the district of Magwe —are located on the left or eastern bank of the river. The field on the western slope—Yenangyat in Pakokku district, Minbu in Minbu district, and Minhla in Thayetmyo district—have never been so successful. The Kyaukpyu and Akyab fields on the Bay of Bengal are almost negligible. About 150 Americans—oil drillers, bosses and superintendents—are employed in the oil fields of the Irrawaddy valley. The production of petroleum is practically in the hands of Americans, and Yenangyaung, Chauk and Yenangyat are to all purposes American towns.

The production in gallons of each of these fields for the years 1915-1917, respectively, was as follows:

Fields	1915 Gal.	1916 Gal.	1917 Gal.
Yenangyaung	198,809,315	240,194,063	176,979,020
Singu	77,005,880	44,105,013	85,639,166
Yenangyat	4,099,345	5,310,740	6,620,908
Minbu	2,316,207	2,043,542	3,468,382
Minhla	25,920	35,000	30,000
Kyaukpyu	23,220	68,843	46,821
Akyab	12,045	11,882	10,894
Total	282,291,932	291,769,083	272,795,191

The output for 1917 was 19,000,000 gal. less than that of the record year of 1916, and nearly 10,000,000 gal. less than that of 1915. The decline during the past year was in the Yenangyaung field (the Singu, Yenangyat and Minbu fields showed a marked increase) and was due to the lack of tonnage to move the product and to the difficulty in getting piping and other supplies.

The Government of Burma is doing everything possible to encourage the production of tungsten, and its efforts have been attended with good results. The 1917 output of this metal was nearly 25 per cent greater than that of 1916, which, in turn, was nearly 50 per cent greater than that of 1915. The increased production of tungsten ore and the high price of tin, which is found associated with the tungsten, has led to a similar increase in the output of this metal.

Tungsten ore (wolframite) and tin ore are obtained in extreme southeastern Burma, in the narrow strip where the mountains, which separate Burma from Siam, slope down toward the coast of the Bay of Bengal, the Gulf of Martaban, and the valley of the Sittang River above the head of the gulf. This region, of which the district of Tavoy is the center, claims to be the chief wolfram-producing region of the world. What promises to be an important field was recently discovered in the district of Yamethin, on the border of the southern Shan States in the upper valley of the Sittang. The production of wolfram and tin for the years 1915-1917 was as follows: In the districts of Tavoy, Mergui, southern Shan States and Thaton, wolfram ore, 11,761 tons; in the same districts, with the addition of Amherst, tin ore, 1385 tons, and in Mergui alone, block tin, 382 tons.

—

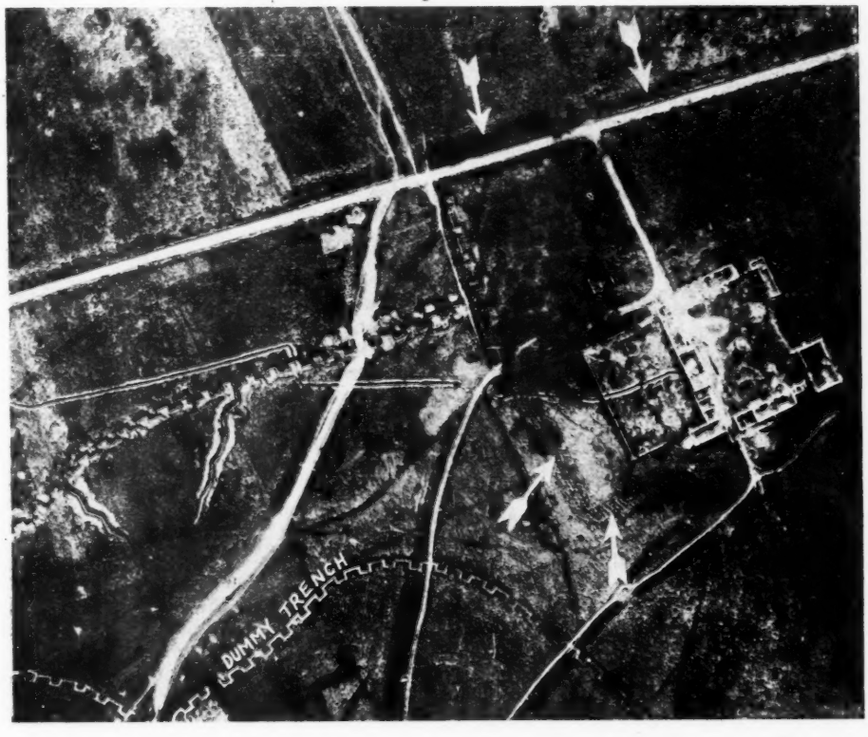
Olds Price Advance Rescinded

DETROIT, Nov. 25—The Olds Motors Works, Lansing, Mich., has withdrawn the advanced prices announced about Oct. 1 last. At that time the material and war tax situation apparently justified an advance which, now that peace is here, appears unnecessary. Oldsmobile distributers, therefore, have been advised that the scale of prices in force prior to Oct. 1 last will rule. Present production at the Olds plant consists of coupes and sedans, a limitation on production which likely will persist until after the first of the year.

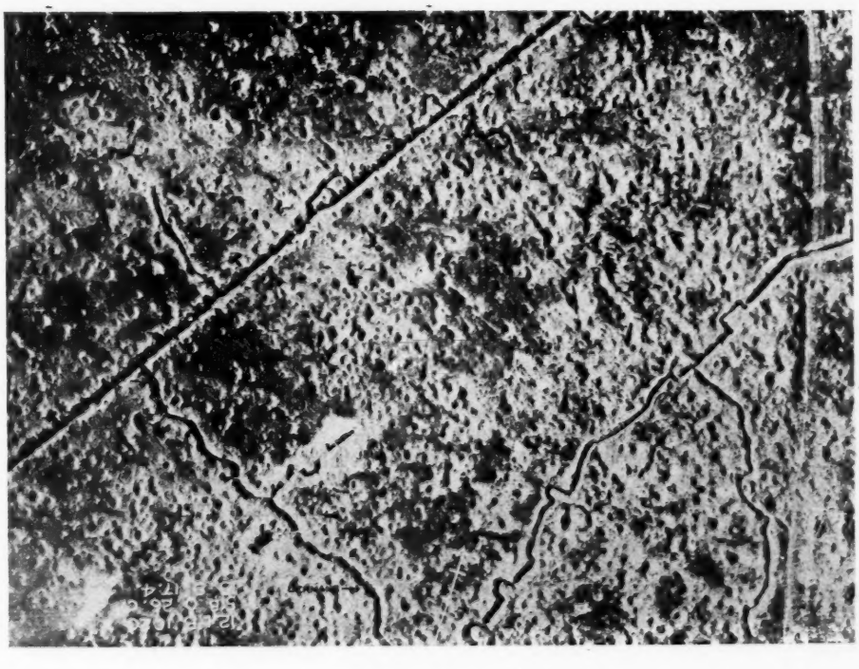
—

Views From an Airplane Camera

—



The arrow shows a "Trou de loup" guarding a farm. The true worth of the airplane camera is made plain by this picture, which plainly distinguishes between the real trenches and the dummies. The eye cannot distinguish the dtfference, but to the camera the dummy throws no shadow



This view was taken while the British were charging to the German second line trenches, having taken the first line. Unfortunately the altitude of the plane was too great to reveal the troops in detail

Intelligent Selection Cuts Turnover

Bureau of Labor Reviews Methods of Plant Where Labor Turnover is But 65%

WASHINGTON, Nov. 23—The October issue of the Monthly Review of the United States Bureau of Labor Statistics contains an article by Dr. Boris Emmet, which shows that a large motor-vehicle manufacturing concern in the Middle West has been remarkably successful in keeping labor turnover down by using intelligent methods in selecting and handling its labor force.

Twenty-two plants in the same locality were studied by the Bureau of Labor Statistics, of which only four had a turnover of less than 100 per cent per annum, while a turnover as high as 500 per cent is not unusual. The turnover in the particular plant referred to above has not exceeded 75 per cent per annum since 1915, and for the year ended April 1, 1918, the turnover was less than 65 per cent.

Doctor Emmet found that the company's labor policy had much to do with keeping down the turnover. This company favors hiring married men past 35 years of age and residents of the city where its plant is located, for there is little to draw them away. There is no objection to union membership. Wages are adjusted in accordance with changes in the cost of living, ascertained by studies and records kept by workingmen's families.

Committees of workmen are encouraged to get in touch with the management to discuss or forestall grievances. Good working conditions and good treatment of employees are insisted upon, and no scheme of payment that may appear to drive the workers is introduced.

The management realized quickly after the war broke out that living costs must be met by wage increases if labor turnover were to remain low. Late in 1917 it was announced that future wage adjustments would be based on the cost of living. A study of local prices was made, as a result of which it was found, for example, that in November, 1917, a local family of 5 spent on the average $41 for food, $22 for rent, $10 for heat and light, $10 for clothes and $7 for miscellaneous purchases, a total of $90 a month. The wage rate was set high enough to provide a comfortable margin over this figure, and at present initial wage rates are about $24 a week for adults on the day force. Length of service means increased pay, and considerably more than half the day men make from $25 to $35 weekly.

Committees which meet company representatives to adjust or prevent disputes are elected by popular vote, and their personnel changes monthly, thus giving more employees a chance to serve.

Night workers are less likely to remain away from work than those employed during the day. The probability that this condition may hold good generally appears from the facts that night workers can attend to personal business during the day, that because they are better paid they lose more money in staying away, and that because they are, in general, young men they are less liable to sickness than the day workers.

—

Ford Leaves Ford Motor

DETROIT, Nov. 25—Henry Ford is withdrawing from active participation in the Ford Motor Co. to become a newspaper publisher and to give more time to Henry Ford & Son's tractor business. The new publication, which is to be issued once a week, will be printed in Dearborn, Mich. It is to be known as Henry Ford's National Weekly. E. G. Pipp, former editor-in-chief of the Detroit News, is editor.

Utilization of the great Ford selling organization to put the publication on the market nationally is planned by the directors of the weekly. Just how this will be done has not been announced, but it is presumed that every Ford car, truck and tractor dealer will be a circulation agent for the paper. The aim of the publishers is to establish a circulation of one million copies within 6 months, and to assure this the Ford organization will be used. Ford's son Edsall will take his father's place in the Ford Motor Co.

—

Automobile Agency Wanted

WASHINGTON, Nov. 25—The Department of Commerce reports an individual in the Netherlands desiring an agency for automobiles, motorcycles and oil motors for vessels. Payment will be made in Dutch currency on arrival of the goods. Correspondence can be made in English. Further information can be secured by asking the Bureau of Foreign and Domestic Commerce with regard to "foreign trade opportunity No. 27713."

—

Automobiles and Motorcycles in Australia

MELBOURNE, Oct. 24—The following table gives the number of passenger cars and motorcycles in use in the Commonwealth of Australia. Figures for Western Australia are not available at this time, therefore those for New South Wales, Victoria, South Australia and Tasmania only are given. South Australia totals are as of Sept. 30, 1918; the others are as of June 30.

Census of Motor Vehicles in Australia

	Queensland	New South Wales	Victoria	South Australia	Tasmania	Total
Cars	2,404	20,645	14,142	8,512	1,890	47,593
Motorcycles	688	8,532	9,530	6,958	1,425	27,133
Totals	3,092	29,177	23,672	15,470	3,315	74,726

To Use Army Trucks for Mail

Post Office Makes First Move Toward Their General Adoption—Halve Mail Cost

WASHINGTON, Nov. 25—The first step toward extensive use of Army trucks for mail service with discharged enlisted men as drivers was taken Saturday by the Post Office Department when it requested the War Department to release 7 trucks and 4 men for a 115-mile star route between Helper and Vernal, Utah.

This route now costs the Government $78,000 a year, and it is estimated that by the use of Army trucks, and payment of $4 per day to former soldier chauffeurs, the cost can be cut in half.

The Post Office will request 400 additional trucks and men shortly and increase the numbers as Army demobilization proceeds. It plans an interlacing motor truck system with terminals extending from the Atlantic to the Pacific coasts in the form of a U-shaped route with the three points at Portland, Me.; New Orleans, and Portland, Ore.

At present a Portland, Me., and New Orleans route is in operation with a 12-day schedule between the two cities. Motor truck routes have been operating successfully from the financial standpoint, one of 135 miles earning $16,000 a month with an upkeep cost of $800.

20,000 Army Trucks Available

It is expected that 20,000 motor trucks will be released by the War Department for this rural mail service.

According to the bill proposed by Congress, Army trucks and airplanes can be and are to be turned over to the postal officials by the War Department as they can be used for postal service, following the war, as they are demanded by the Post Office. It is the plan that the Post Office authorities are operating and subjecting to use thousands of motor trucks. The general plan also includes the establishment of mail service by truck, chiefly at points where there is neither rail nor water facilities for hauling the mail matter, and by means of this it is expected that the territory of the United States which is now not enjoying the benefit of first class mail service will be efficiently linked with rail and water transportation, by means of the motor trucks.

Will Improve Communication

According to Fourth Assistant Postmaster James Blakslee, the introduction of a huge number of motor trucks into the mail service will consequently tend to complete the mail service throughout the nation, make more efficient the rural district life, especially those now suffering from poor means of communication and transportation, and will further tend to increase the importance of many communities which are now out of proper contact with the railroads and waterways.

Domestic Manganese Supply Doubled

U. S. Mines Now Produce One-Third of High-Grade Ore Needed by Nation

WASHINGTON, Nov. 25 — Domestic mines now supply one-third of the high-grade manganese ore used in the United States. This is an extraordinary increase over the production of 1917 when the domestic mines supplied only one-sixth of the ore needed. During the first 6 months of 1918 shipments of ore contained more than 35 per cent of manganese, total 136,554 tons, and in October this grade of ore was being shipped at a rate of 28,000 tons monthly, or 336,000 tons a year.

Estimated Output 324,000 Tons

It is estimated that the total production of high-grade manganese in this country in 1918 will be 324,000 tons. The extraordinary increase in the output in 1918 has fully offset the loss occasioned by the restriction of imports made necessary by the shortage of ships and has established confidence in the capacity of the domestic deposits to supply a considerable part of domestic need, according to the United States Geological Survey, Department of the Interior, which has just completed investigation of the manganese ore industry in this country.

Imports of manganese ore by all sources in the first half of 1918 were 244,836 tons. The shipments from abroad came from Brazil, Cuba, India, Chile, Costa Rica and several other countries shipping small quantities. Brazil supplied the greatest amount, shipping in all 171,895 tons. Below is the table showing in detail the domestic shipments of manganese for the first 6 months of 1918:

—

Nash Returns to Kenosha.

WASHINGTON, Nov. 26—Charles W. Nash, who has been chief in charge of production and engineering for the Bureau of Aircraft Production, has returned to Kenosha. With both Ryan and Nash out, this bureau is now without a head.

MANGANESE AND MANGANIFEROUS ORE (GROSS TONS) SHIPPED, JANUARY 1 TO JUNE 30, 1918, AND U NITED STATES GEOLOGICAL SURVEY'S ESTIMATE OF SHIPMENTS DURING THE YEAR 1918

State	Ore Containing 35 per Cent of Manganese or More			Ore Containing 10 to 35 per Cent of Manganese			Ore Containing Less than 10 per Cent of Manganese		
	Jan. 1 to June 30		U.S.G.S. Estimate for Year	Jan. 1 to June 30		U.S.G.S. Estimate for Year	Jan. 1 to June 30		U.S.G.S. Estimate for Year
	Number of Shippers	Quantity of Ore		Number of Shippers	Quantity of Ore		Number of Shippers	Quantity o Ore	
Alabama	1	53	600	2	85	630	.....	.....	.....
Arizona:									
Bisbee district	6	7,159	13,290	.....	.....	.....	.....	.....	.....
Other districts	11	2,703	5,572	2	4,609	6,237	1	6,082	6,250
Arkansas: Batesville district	10	4,089	11,000	10	3,534	8,500	.....	.....	.....
California	31	10,601	22,158	1	31	100	.....	.....	.....
Colorado:									
Leadville district	.....	.....	.....	11	*60,804	*125,000	*	*	*
Other districts	1	67	150	.....	.....	.....	.....	.....	.....
Georgia	8	1,963	5,850	5	5,151	10,520	1	300	1,000
Michigan	.....	.....	.....	1	5,534	22,500	.....	.....	.....
Minnesota: Cuyuna district	.....	.....	.....	9	223,332	625,000	2	82,309	325,000
Montana:									
Butte district	5	28,986	78,500	.....	.....	.....	.....	.....	.....
Phillipsburg district	18	58,312	133,700	.....	.....	.....	.....	.....	.....
Other districts	1	40	500	.....	.....	.....	.....	.....	.....
Nevada	11	12,586	26,870	2	40,327	85,030	.....	.....	.....
New Jersey	.....	.....	100	†	†	†	.....	.....	.....
New Mexico:									
Silver City district	1	120	250	2	6,978	21,050	.....	.....	.....
Other districts	2	312	500	1	1,609	1,609	.....	.....	.....
North Carolina	1	244	250	.....	.....	.....	.....	.....	.....
Oregon	1	150	500	.....	.....	.....	.....	.....	.....
South Carolina	1	100	250	1	850	850	.....	.....	.....
South Dakota	1	31	31	.....	.....	50	.....	.....	.....
Tennessee	11	840	3,600	4	959	2,350	.....	.....	.....
Texas	1	207	800	.....	.....	.....	.....	.....	.....
Utah	7	3,701	6,305	.....	.....	.....	.....	.....	.....
Virginia	13	4,280	13,800	12	5,206	14,440	2	3,624	7,700
Wisconsin	.....	.....	.....	.....	.....	.....	1	93,741	200,000
	142	136,554	324,576	†63	‡314,137	‡832,866	7	‡§86,233	‡§333,700

*Fluxing ore not included or not reported.
†Shippers of residuum and quantity of residuum shipped not reported.
‡The part of the ore from Arizona and Nevada that was used for fluxing is not included in total for United States.
§Ore from Wisconsin, containing approximately 5 per cent manganese, not included in total.

Zinc Rolled in the United States, 1915-1917

	1915	1916	1917
Zinc sheets:			
Quantity, pounds	77,567,096	73,760,938	90,002,569
Value	$10,952,609	$13,758,613	$16,465,052
Average value per pound	$0.14	$0.185	$0.18
Boiler plates and special sheets:			
Quantity, pounds	2,562,856	3,198,693	6,900,293
Value	$345,572	$564,814	$1,111,240
Average value per pound	$0.135	$0.175	$0.16
Zinc strips:			
Quantity, pounds	10,295,859	18,682,653	20,350,089
Value	$1,445,806	$3,299,386	$3,190,559
Average value per pound	$0.14	$0.17	$0.155
Total rolled zinc, pounds	90,425,811	95,642,284	117,252,951
Total value	$12,743,987	$17,622,813	$20,766,851
Average value per pound	$0.141	$0.184	$0.177
Rolled zinc exported:			
Quantity, pounds	*	25,024,182	33,027,991
Value	.....	$4,540,146	$5,730,792
Average value per pound	.....	$0.181	$0.174
Domestic consumption of rolled zinc, pounds	.....	70,618,102	84,224,960

*Figures not available.

U. S. Production of Rolled Zinc

Both Quantity and Price Have Increased Steadily Since 1915

WASHINGTON, Nov. 26—It is a curious fact that although the Geological Survey Department has for many years collected statistics showing the production of zinc, it has not been possible to publish figures showing the production of rolled zinc. The reason is that the output heretofore has been practically in the hands of two companies and publication would have disclosed individual business.

Since the beginning of the war the increased demand for sheet zinc with which to line packing cases for shipment overseas has been so great as to afford inducement to many other companies to engage in the zinc-rolling business and, it is possible to give figures.

—

Modify Truck Order Cancellations

WASHINGTON, Nov. 26—Owing to the fact that some of the manufacturers of commercial trucks who received orders from the Government prior to the signing of the armistice had more fabricated materials on hand than others, the wholesale cancellation of 50 per cent of all commercial truck orders which was announced last week has been slightly modified and readjusted.

In those plants where there was little or no fabricated material found, the cancellations were increased above 50 per cent, while in those where the Government found a larger amount of materials which meant greater waste of materials with the 50 per cent cancellation, the cancellations were readjusted.

The amounts of regulations or increase of the cancellations was not made public by the Government. An official stated, however, that the changes were not due to demands from General Pershing, and were not important changes numerically. They were merely the readjustment that is being made by each department which following cancellations investigates the materials on hand and then readjusts the contracts.

Export Regulations Modified

Import Rules, Too, Altered Following Signing of Armistice—Bars Let Down

WASHINGTON, Nov. 22—The signing of the armistice has allowed the War Trade Board to modify some of its regulations governing the exportation and importation of commodities, the changes including an additional import of rubber of 7500 tons up to Jan. 1, 1919, and the export of Sea Island and Egyptian cotton. Any hides and skins, not including fur skins, can also be imported hereafter provided that such skins were all contracted for by the American importer prior to Jan. 15, 1918.

The War Trade Board will, it announced, also grant export licenses more freely than heretofore on various commodities. It will not specify the number of licenses nor the commodities, but asks the exporters and importers to make their requests and state explicitly if the licenses are required for business which is actually in need, together with the dates of the orders.

The strictest regulations on exports will be confined hereafter to Europe and Siberia, which will require regulations inducive to the rehabilitation of those sections of the globe. Restrictions will also be placed to some extent on the exportation of bulky commodities by reason of the scarcity of tonnage.

The return of troops, carriage of supplies for troops not yet returned, and carriage of commodities necessary for the relief and construction abroad oblige the War Trade Board to continue its supervision and limit the increase in tonnage engaged in non-regulated trade.

The War Trade Board also calls the attention of exporters to the fact that the Trading with the Enemy Act still remains in force and effect.

—

All Building Construction Permitted

WASHINGTON, Nov. 22—All remaining restrictions on non-war construction throughout the United States were officially removed to-day by the War Industries Board. This permits all building operations of whatever character to proceed. No further permits will be required from the War Industries Board or the State councils.

—

Exports of Oil from Tampico

WASHINGTON, Nov. 23—Declared exports of crude oil and petroleum products from the Tampico district, Mexico, to the United States in September, 1918, amounted to 4,038,167 bbl., according to a report by Vice-Consul D. A. Willson. The movement from Tampico was 2,785,935 bbl.; from Tuxpam, 842,774 bbl., and from the new loading station at Port Lobos, 409,458 bbl.

Shipments to points other than the United States during the same period were reported as 1,047,554 bbl.; the movement from Tampico was 540,807 bbl.; from Tuxpam, 442,212 bbl., and 64,535 bbl. from Port Lobos. The gross shipments, therefore, reached a total of 5,085,721 bbl., or a greater amount than ever shipped from this consular district. The above shipments included refined products as follows:

Products	From Tampico Barrels	From Tuxpam Barrels
Reduced, crude	732,500	.....
Distillate	187,000	18,515
Topped crude	138,000	18,080
Gasoline	179	.....
Naphtha	121,000	.....

The destination of oil shipments during the month was as follows:

Destination	From Tampico Barrels	From Tuxpam Barrels	From Port Lobos Barrels
United States	2,785,935	842,774	409,458
Dominican Republic	10,128	.....	.....
Chile	213,329	100,310	64,535
Cuba	38,864	.....	.....
Canada	.....	26,826	.....
England	246,466	.....	.....
Guatemala	32,020	.....	.....
Mexico	.....	315,076	.....
Total	3,326,742	1,284,986	473,993

—

Increase Rubber Import Permits

WASHINGTON, Nov. 22—The import restrictions on rubber have been modified so that the total imports of 25,000 tons which was to be permitted during the last three months of 1918 has been increased to permit the licensing of an additional 7500 tons prior to Jan. 1, 1919. The 32,400 tons will be allocated by the War Trade Board.

—

Fulton Cuts Price $150

FARMINGDALE, L. I., Nov. 25—The Fulton Motor Truck Co. has reduced the price of its standard chassis by $150. The old price was $2,000 and the new price is $1,850.

—

Airplane Contracts Canceled

WASHINGTON, Nov. 22—Two hundred and twenty-five million dollars worth of orders for airplanes, engines, parts and instruments have been canceled by the Bureau of Aircraft Production, according to a statement by Secretary of War Newton D. Baker. These orders were largely those on which production had not yet started.

—

Start Navy Air Mail Service

WASHINGTON, Nov. 25—An aerial mail service between the Aero Station at Anacostia, D. C., and Norfolk, Va., naval base will be inaugurated shortly by the Navy Department. It will carry official mail only and will in no way conflict with the postal air service.

—

Cancel South Carolina Hangar Project

WASHINGTON, Nov. 22—The War Department has canceled the contract for the construction of a steel hangar at North Camp Jackson, South Carolina.

Cut All Production Restrictions

No Official Word from W. I. B. But N. A. C. C. Assumes Such Will Be True Jan. 1

WASHINGTON, Nov. 25—It seems probable that definite word removing all restrictions on the manufacture of passenger cars and trucks will be forthcoming in the very near future. The National Automobile Chamber of Commerce already has come to this conclusion and has announced in a circular to its members that "after Jan. 1 there will be no limitation of any kind on the manufacture of passenger cars or trucks."

Actually no word of authority has come from the War Industries Board. Charles C. Hanch, chairman of the Automotive Products Section of this board, has officially told manufacturers that their pledges to the board will be canceled after Jan. 1. In view of this fact, and after consultation with Hanch and other members of the Priorities Board, the N. A. C. C. has come to the conclusion that all restrictions are to be lifted Jan. 1.

Rhodes Baker, of the Priorities Board, who has been the official point of contact between this board and the manufacturers, has resigned and left the national capital.

—

Siam's Output of Tin and Tungsten

WASHINGTON, Nov. 22—According to an official estimate received from the Vice-Consul at Siam, the output of metallic tin in 1917 was 9466 short tons as compared with 10,078 short tons in 1916. Tungsten ore recovered in 1917 amounted to 800 short tons as against 584 short tons in the previous year.

The Siamese Government collects a royalty on tin and tin ore amounting to 25 per cent of the market price in Singapore, the fluctuation in value at the latter place being adjusted and the rate reckoned according to a "royalty scale" published in the Siamese Government Gazette from time to time. A recent issue of this Gazette notified an extension of the "royalty curve" to meet the increased price of tin. According to telegraphic advice from Singapore the price of tin on Aug. 29 was $162 per picul, which is approximately 7 per cent of a ton, and at that figure 50 tons had been sold.

A recent order in the Government Gazette announced that the royalty on tungsten ore, which was previously collected at the same rates as in force on tin ore, had been reduced to 10 per cent ad valorem.

—

New Joints for Templar

CLEVELAND, Nov. 25—The Templar Motors Corp. has adopted Thermoid universal joints for use in its latest model.

Gasoline Production Drops Slightly

Nine Months' Totals Are Satisfactory—Stocks Show a Decrease

PRODUCTION

	September, 1918	August, 1918
Crude oil (bbl.)	28,390,431	28,534,275
Gasoline (gal.)	314,595,959	330,335,046
	—Stocks on Hand— Sept. 30, 1918	Aug. 31, 1918
Crude oil (bbl.)	14,462,100	13,946,595
Oils purchased to be re-run (bbl.)	1,312,275	1,082,892
Gasoline (gal.)	269,772,723	285,446,538
Kerosene (gal.)	436,628,907	424,281,481
Gas and fuel (gal.)	583,407,769	569,016,413
Lube. (gal.)	147,425,556	137,496,986
Wax (lb.)	181,044,508	176,197,680
Coke (ton)	16,866	19,912
Asphaltum (ton)	79,424	88,446
Miscellaneous (gal.)	444,353,139	459,891,496

NEW YORK, Nov. 25—Production of both crude oil and gasoline dropped slightly during September as compared with August, but the total production for the first nine months of 1918 is well ahead of that for a similar period in 1917. Stocks of both gasoline and crude have again decreased slightly.

During September the daily average production of gasoline was 10,486,532 gal., as against 10,655,969 gal. in August. When considering these average figures it should be remembered that September has one day less than August.

Stocks of gasoline on hand as of Sept. 30 are 60,562,323 gal. less than the quantity on hand Aug. 31. During September the production of crude oil dropped 143,844 bbl., and stocks of crude increased 515,505 bbl.

Taking to nine months' totals it will be found that the production of both crude and gasoline have increased by 6,355,687 bbl. and 586,428,698 gal. respectively. The stock of kerosene shows a slight decrease, but, on the other hand, that of fuel oil shows an appreciable gain.

—

Eliminate Gasoline Tax

WASHINGTON, Nov. 25—The Senate Finance Committee, which is revising the new War Revenue Bill, has cut out of it the proposed tax of 2 cents a gallon on gasoline.

—

Bituminous Storage Limit Off

WASHINGTON, Nov. 25—All storage restrictions on bituminous coal have been removed by the United States Fuel Administration in conformity to the action of the War Industries Board in canceling its preferential industries list. Anthracite coal is not affected, however, by the ruling of the Fuel Administration.

Every industry in the country now may store as much bituminous coal as desired or obtainable, as the action of the War Industries Board removes the necessity for the Fuel Administration to distinguish longer among different classes of industrial plants.

—

Boston Dealers After Business

BOSTON, Nov. 23—The armistice and proposed peace has rejuvenated dealers in this city. Now they are planning to go after business again. And in order to get facts at first hand they have journeyed to the factories to learn things. On one train from Boston last week there were enough dealers to nearly fill an entire Pullman sleeper. They were heading for Cleveland, Detroit and Toledo.

—

Portland Cement Association's Dinner

CHICAGO, Nov. 20—The annual dinner of the Portland Cement Association will be held at the Biltmore, New York, on Wednesday, Dec. 11.

New Samson Tractor at $650

General Motors Develops 2-plow Machine to Compete With Fordson—Out Soon

NEW YORK, Nov. 25—The General Motors Corp. is shortly to enter the market with a new small farm tractor in a price field to compete with the Ford. This will be known as the Model M Samson and will sell for $650. It is to be a 2-3-pow machine designed to pull two 14-in. plows under all conditions and three plows under favorable conditions.

It is understood that this model is to be in addition to the present Samson model, which is somewhat larger and sells for in the neighborhood of $1,750. The new machine is to be built in the Janesville, Wis., plant which the company recently acquired and which is now actively being placed in condition for production. It is stated that the machine will be sold by the tractor selling division of the General Motors Corp.

—

Investigate Labor Conditions

WASHINGTON, Nov. 22—The United States Employment Service is making an analysis of the labor conditions in industrial centers throughout the country in co-operation with the War Department and the War Industries Board. Approximately 100 industrial centers and 100 industries will be covered by the investigation. The inquiry will be conducted by the community labor boards of the service, which will secure their information by means of personal contact and telephone communication with employers, plant managers, employment managers, labor organizations, commercial bodies, the local employment offices of the service and other sources.

Total Output of Refineries in the United States for 1917

1917	Crude (bbl.)	Other Oils (bbl.)	Gasoline (gallons)	Kerosene (gallons)	Gas and Fuel (gallons)	Lubricating (gallons)	Wax (pounds)	Coke (tons)	Asphaltum (tons)	Miscellaneous (gallons)	Losses (bbls.)
January	24,839,772		203,618,724	137,248,370	469,596,208	60,941,062	39,558,627	44,627	49.894	27,331,019	941,924
February	23,083,433	no account	184,602,595	129,074.504	446,964,925	54,631,765	36,370,297	42.047	40 619	23,685,686	941,110
March	26,230,138	1st 6 mo.	220.523.571	159,028.978	494,855,838	64,345,221	40,868,930	48,839	52.823	26,977,334	870,380
April	25,994,938	1917	228,945.164	157,826.945	462,846,339	63,218,215	41,037,511	46.099	52 849	30,959,901	957,533
May	27,253,391		238,816,209	147,894,846	504,859,695	65,926,007	38,686.364	43,535	67,612	31,086,377	979,245
June	26,453,210		233,671,746	151,477,333	496,742,434	61 045,757	38,075,280	42,513	67,931	30,205,172	1,011,568
July	26,776,856	2,435.533	244,145,292	161,679,053	599,454,966	64,335,905	40,158,033	42.641	65 272	92,359,401	1,111,511
August	27,900,623	2,376,580	254,464,491	149,528,513	632,151,971	64,107,817	38.999 341	46,240	73,878	92,708,312	1,286,141
September	27,529,022	2,632,988	256,132,050	143,203,644	629,914,572	60.757,049	48,300,033	42,986	62,520	80,386,471	1,182,560
Total first nine months	236,061,383	7,445,101	2,064,919.842	1,336,962.186	4,737,386,948	559.308,798	362,054,416	399.527	533.398	435,699,673	9.281,972
October	27,698,023	2,863,518	271,891,234	140.559,542	621,492,374	68,516,071	41,181,400	48,849	73,886	91,804 160	1.355,219
November	26,215,979	2,519 700	264,888.709	125 893,202	592,490.037	64.861,375	39.694 595	45.815	73.289	87,115.002	1,203.110
December	25,155,996	2,069,351	248,846,638	123,354,046	561,954,921	61,090,596	38,269,670	45,175	58,852	87,548.408	1,233,528
Total	315,131,681	14,897.670	2,850,546,423	1,726,768,976	6,513,324,280	753,776,840	481,200,081	539,366	739,425	702,167,243	13,073,829

Total Output of Refineries in U. S. for First Nine Months of 1918

1918											
January	23,842,587	2,300,334	242,632,044	119,358,184	547 866,248	56,625,425	39,238,858	41,216	54.854	70,995,829	1,078,181
February	23,386,676	2,298,333	234,324,619	121,218,320	510,165 397	58,300,914	35,087,337	42,371	42.033	75,134 088	983,992
March	26,239,662	3,696,872	269,647,968	151,228,007	587,985,804	69,308 351	43.597,019	44,248	56,901	94,865,148	1,097,489
April	26,201,544	3,956,244	293,396.162	153,703.682	578.255.341	71,022 204	40.173,524	45,674	51,242	89,242,012	1,182,020
May	28,510,698	4,112.023	319,391,202	160,590,760	631,586,209	79,589,755	42,544.633	48,864	60,449	88,627,491	1,269,281
June	28 140.479	3,483.270	315,023.445	151,840.252	628,842.033	74.420 996	41.317,794	46,605	50.321	81,110,922	1,282,177
July	29,170,718	5,951,537	332,022,095	156,828.826	658,439.682	79,303,107	41,691,551	48,914	58.433	159,374.139	1.338 304
August	28,534,275	6,376.353	330,335 046	149 678.850	671.113.871	72,892 879	41.829,516	51,759	59.715	163,355,034	1.337,327
September	28,390,431	5,485,747	314,595,959	164,963,798	653,085,050	70,593,079	42,704.894	48,052	49,157	138,201,963	1,236,834
	242,417,070	37,660,713	2,651,348,540	1,329,410,679	5,467,339,635	632,054,690	368,185,126	417,703	483,105	960,896,626	10,805,705

Suggests War Automotive Exhibition

Such An Event, Arranged on an Elaborate Scale, Would Bring Home the Importance of Cars, Trucks, Tractors and Airplanes in Winning the War

By W. F. Bradley*

PARIS, Nov. 1—Special Correspondence—Several million Americans deeply interested in all that pertains to the automobile will hail the end of the war without having had an opportunity of fully appreciating the work that gasoline has done toward securing a victorious peace. The story of the automobile in the war never has been fully told.

The probabilities are that it never will receive justice in written word. In European war circles there always has been a fear of giving too much credit to the automobile services of the Army. When I wrote the story of how automobiles held at bay the Crown Prince's forces at Verdun, the French military censor objected to the opening sentence, "Automobiles saved Verdun." He did not question the accuracy of the assertion, but he was afraid of slighting the infantry and artillery services.

Yet it is on official record that automobiles were the decisive factor in three great battles. Also, now that Austria has ceased to be an enemy, it can be stated that the only reason the Italians did not follow up the first victory on the Piave River was owing to lack of adequate automobile transportation. Had there been a big reserve of trucks, the Caporetto disaster could have been retrieved immediately.

Huge Automotive Demonstration

The American automobile industry should organize on an elaborate scale, and as soon after the declaration of peace as practicable, a huge demonstration of the automobile at the war. By the term "automobile" is meant everything which employs gasoline as its motive power. This naturally brings in the airplane.

No lifeless, inanimate exhibition will satisfy full-blooded Americans who have had the unappreciated good fortune to follow the war across three thousand miles of sea water. What is required, and what is proposed, is a practical open-air exhibition, as closely approaching natural conditions as possible, of what the automobile has done to help win the war. This is a big program; it is an elaborate job. But the American automobile industry can handle it, and should handle it.

In this exhibition we want to see the various Allied and enemy airplanes which have been in service on the front. For instance, what American would not travel halfway across the continent to see Eddie Rickenbacher's Spad scout plane, at this moment riddled with more than forty bullets, in actual combat with a real German plane piloted by somebody who had consented, for the time being, to play the role of the Boche?

How many Americans have seen a chasse squadron in battle formation? How many have seen a bombing group take the air with chasse planes as a protecting escort? How many have seen anti-aircraft guns in action against a number of planes high up in a clear sky, and have watched the efforts of the pilots to escape that deadly fire? How many have seen an airplane attack a captive balloon, fly low over trenches with machine guns going, or "pancake" down with a dead motor on shell torn ground? All this should be a part of the program of the automobile exhibition.

Would Show Everything

Readers of war news picture airplanes operating from a prepared ground and flying away to a new place whenever it becomes necessary to change location. It is not generally realized that with every squadron of 18 airplanes there are in direct attendance from 16 to 18 trucks or touring cars and nearly as many trailers, without which the planes could not remain in the field for a single day. The airplane, the most mobile of all units, is the one most dependent on automobile transportation. The airplane trucks and trailers should be shown in actual operation just as they performed in the Argonne, the Somme and the Marne.

It should be shown how an observation balloon squadron works. The "sausages" should be sent up from the mobile automobile winches, brought down hurriedly when an enemy attack is pending, covered and camouflaged to hide them from spying eyes, and shown packed up ready for transportation. There should be telephone cars in communication with the men up aloft, and motorcycle dispatch riders ready to carry urgent messages to commanding officers.

The work of the automobile in connection with artillery is itself sufficient to form an exhibition of more than ordinary interest. There should be shown the French four-wheel drive tractors, the Italian mountain tractors, the special British machines and the American self-track layers specially designed for hauling guns.

Machines and men who have had actual service on the front should show how guns are brought into position, dropped into gullies, hauled up hill sides, supplied with shells, all without the use of horses. The special gun carriages, designed on automobiles lines, and made to be towed by automobiles, should be given a prominent place. There is need, too, for automobile trucks — many of which never even have been described—which carry guns on and fire from their own platform.

Tanks and armored cars constitute the most spectacular feature of any exhibition. Not only should all of them be shown, but they should operate as nearly as possible under conditions approaching actual warfare. Army searchlights are nearly all of the automobile type. Here there is a wonderful opportunity for a spectacular display comprising night flying and infantry attacks with the use of searchlights.

A war automobile exhibition could best be combined with a series of track races, for the war has had a most direct influence on speed. Indianapolis, for instance, is well placed for staging such a show. The world's short-distance speed record officially belongs to Germany for, although Arthur Duray and his 300-hp. Italian Fiat put up much faster time, official recognition was never given this performance.

In a conversation the other day one of the Fiat engineers stated, "As soon as the war is over we can put a 400-hp. aviation motor in a chassis weighing less than 2000 lb., and I believe we can establish a record of 3 miles a minute." A few days later the engineer of a French firm indicated his intention of trying to put up the same record in a similar manner. There are three European firms with a program and racing cars ready for after the war, and there are a dozen others ready to make a start. There will be no lack of racing interest.

It will take time, money and hard work to organize a creditable war automobile exhibition. But the job is worth while.

*This article was written prior to the signing of the armistice.—EDITOR.

More Post Office Trucks

NEW YORK, Nov. 26 — The motor truck service of the New York Post office Department is soon to be very considerably expanded. At the present time, there are less than 100 trucks in service, and this is to be increased to 270. It is proposed to put in service in the very near future, the following vehicles:

10—1½-ton	White
90—1½-ton	Packard
99— ¾-ton	White
43—3-ton	White
28	Ford

5000th Packard-Liberty Shipped

DETROIT, Nov. 26—The Packard Motor Car Co. shipped its 5000th Liberty engine on Nov. 21, practically one year after the first engine of this kind to be produced by the company. It was on Thanksgiving Day, 1917, that actual production was started. Production on the original order for 6,000 will be completed in less than 30 days at the present rate of output.

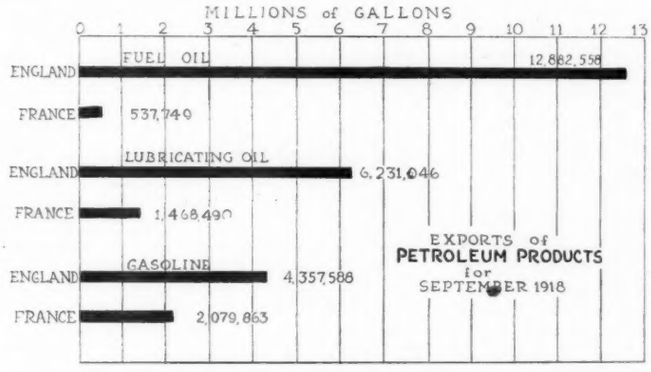
Peterson Joins Koehler

NEWARK, N. J., Nov. 26—Carl D. Peterson has become affiliated with the H. J. Koehler Motors Corp. in the capacity of engineer. He will have charge of the design and production of the new 3½- and 5-ton trucks and 7- and 10-ton road tractors which the company is shortly to place on the market.

AUTOMOTIVE MATERIALS MARKETS

Materials Market Prices

Acids:
Muriatic, lb. ..... .02 -.03
Phosphoric (85%).. .35 -.39
Sulphuric (60), lb.. .006
Aluminum:
Ingot, lb. ..... .33
Sheets (18 gage or more), lb. ..... .42
Antimony, lb. ..... .13¾-.13⅞
Burlap:
8 oz., yd..... .17¼-.17½
10½ oz., yd..... .21½-.22
Copper:
Elec., lb. ..... .26
Lake, lb. ..... .26
Fabric, Tire (17¼ oz.):
Sea Is., combed, lb.1.65-1.70
Egypt, combed, lb.1.25-1.35
Egypt, carded, lb.1.20-1.30
Peelers, combed, lb.1.05-1.20
Peelers, carded, lb. .95-1.05
Fibre (⅛ in. sheet base), lb. ..... .50
Graphite:
Ceylon, lb. ..... .09 -.22
Madagascar, lb. ... .10 -.15
Mexico, lb. 03¾
Lead, lb. ..... .08 -.09
Leather:
Hides, lb. ..... .18 -.35¼
Nickel, lb. ..... .40
Oil:
Gasoline:
Auto., gal. ..... .24½
68 to 70 gal..... .30½
Lard:
Prime City, gal..2.30-2.35
Ex. No. 1, gal...1.62
Linseed, gal. 1.63-1.65
Menhaden (Brown) gal. 1.35-1.36
Petroleum (crude),
Kansas, bbl. 2.25
Pennsylvania, bbl..4.00
Rubber:
Ceylon:
First latex pale crepe, lb. ..... .63
Brown, crepe, thin, clear, lb. ..... .60
Smoked, ribbed sheets, lb. .... .61½
Para:
Up River, fine, lb. .68
Up River, coarse, lb. ..... .40
Island, fine, lb... .59
Shellac (orange), lb.. .74 -.75
Spelter ..... .08½-.08¾
Steel:
Angle beams and channels, lb. .... .03
Automobile sheet (see sp. table).
Cold rolled, lb..... .06½
Hot rolled, lb..... .03½
Tin ..... .71 -.72
Tungsten, lb. 2.45-2.50
Waste (cotton), lb... .12¾-.17



During September last our Allies' share of exported petroleum products was 72 per cent of the total. The share of England and France was valued at nearly $7,000,000

AUTOMOBILE SHEET PRICES

(Based on No. 22 Gage. Other gages at usual differentials)

	Primes only per 100 lbs.	Primes when seconds up to 15 per cent are taken per 100 lbs.
Automobile body stock	$5.95	$5.85
Automobile body stock, deep stamping	6.20	6.10
Automobile body stock, extra deep stamping	6.45	6.35
Hood, flat, fender, door and apron, or splash guard stock	6.05	5.95
Crown fender, cowl and radiator casing, extra deep stamping	6.55	6.45
Crown fender, cowl and radiator casing, deep stamping	6.30	6.20

Automobile Sheet Extras for Extreme Widths:
Nos. 17 and 18 over 36 in. to 44 in., 10c. per 100 lb.
Nos. 19 and 21 over 36 in. to 44 in., 30c. per 100 lb.
Nos. 22 to 24 over 26 in. to 40 in., 40c. per 100 lb.
Nos. 22 to 24 over 40 in. to 44 in., 80 per 100 lb.
Black Sheet extras to Apply to Narrow Widths:
Oiling, 10c. per 100 lb.
Patent leveling, 25c. per 100 lb.
Resquaring, 5 per cent of gage price after quality, finish and size extras have been added.
Seconds 10 per cent less than the invoice Pittsburgh price for corresponding primes.

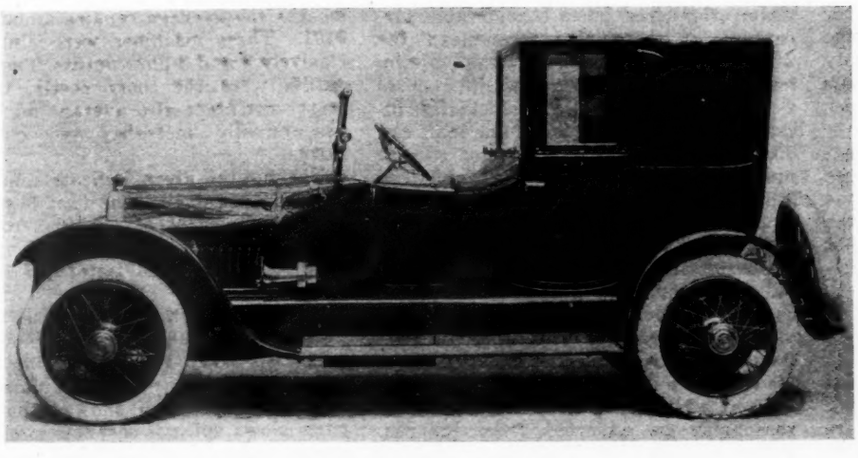
—

Renewed attention is being given in England to the subject of the use of alcohol as motor fuel. A committee to investigate the available sources of supply of industrial alcohol, with particular reference to its manufacture from materials other than those which can be used for food purposes, has recently been appointed by Walter Long. The committee is to investigate the method and cost of such manufacture, and the manner in which alcohol should be used for power purposes. Sir Boverton Redwood, Bart., is chairman of the committee.

—

The London Commissioner of Police has issued a license to the London General Omnibus Co., for 20 motor omnibuses to be operatod on compressed coal gas. The omnibuses will be run under the supervision of the Gas Traction Committee.

An Example of South American Body Building



A cabriolet body built on a Cadillac chassis by Fehling Bros., Buenos Aires. This firm found it necessary to develop body building on account of difficulty and delay in obtaining bodies from the United States

New York State Investigates Its Tractors

Department of Agriculture Finds They Increase Crop Yields But Do Not Materially Decrease Cost of Farm Operations —Reports from 250 Farmers Classified

WASHINGTON, Nov. 23—"Judging by the experience of tractor users, it is not safe to expect any material reduction in the cost of farm operations per acre through the use of the tractor, but it is safe to expect to be able to increase the crop acreage to a very considerable extent and at the same time the amount of crops which one man can raise."

This is the summary of tractor experience in New York State given in a bulletin issued by the United States Department of Agriculture following investigations. Tractors using gasoline or kerosene, says the bulletin, are increasing in numbers on Eastern farms. More than 250 New York State farmers provided the detailed reports of their experiences with tractors during 1917 and the spring of 1918 as the basis for the bulletin, which points out both the advantages and disadvantages of the tractor, the farm conditions, economy of the tractor, and shows that not every farmer will find the tractor profitable.

Farms Are Diversified

The surface of New York State, according to the bulletin, is rolling. The soil is a comparatively heavy loam with heavy clay sub-soil and large and small stones numerous. Some of the larger stones can cause a breakage of the plow or hitch. The farms are diversified, many of them growing at least half a dozen different field crops. Most of the farms it was found grow hay, oats, wheat, corn, barley and beans, with the largest acreage devoted to the first named and decreasing respectively. A small percentage of tractors were found used on farms where more than 40 per cent of the crop acreage was devoted to fruit.

Tractor owners were asked to state the advantages and disadvantages of tractors and the replies show that tractors:

Work more rapidly—More than 50 per cent of the owners pointed out that the tractor performs its work more quickly than horses and that even the 2-plow tractor results in a considerable increase in the plowing rate.

Saves man labor.

Does better work—More than 50 per cent of the farmers replied placing the ability to do better work third in the list of advantages, mentioning also that the best work was evident, and emphasized under hot weather conditions.

Inability to use the tractor satisfactorily until top soil is well dried out was the first disadvantage named.

Packs moist soil—It was found that on the comparatively heavy soil packing was injurious in those spots and there was likelihood of the tractor miring in such places.

Inefficient operators—The difficulty of securing efficient tractor operators was named.

Breakdowns—This was mentioned but is often due to inefficient operation.

Unsatisfactory on rough land.

Unsuitable for small fields.

Lack of power was mentioned by a few, but it is said this is usually the result of error in chosing a machine too small for the work required of it.

Discussing the size of the farm and the tractor the bulletin points out that a farm business must be of sufficient size to justify the tractor. Eighty-four per cent of the tractor owners reported that the tractors have proved profitable investments. Of these more than one-third increase their acreage with tractors. On the other hand, of the men who found the tractors unprofitable only one-tenth increased their acreage.

The comparatively high percentage of tractor owners who have enlarged their farms, says the bulletin, is significant, for although farms have increased in recent years due to improved farm equipment the increase is not so pronounced on farms where tractors are not used.

Tractor Selection Important

A suitable size should be selected for a given acreage, says the bulletin. In New York State the number of 3-plow machines sold in 1916 was less than one-third of the total of 2-plow outfits. In 1917 the 3-plow machines increased and amounted to two-thirds the number of 2-plow rigs, which proves that the 2-plow tractor is showing itself too small. Out of 237 farmers 118 reported 3-plow outfits were more suitable and only 110 recommended the 2-plow size. Nine stated that 4-plow tractors were the best. More than two-thirds of the entire number reporting originally bought 2-plow outfits.

The 2-plow machine is recommended by a majority of farm owners of 150 or fewer crop acres, but a considerable percentage of these also recommend the 2-plow machines which, says the bulletin, leads to the conclusion that in general 2-plow tractors do not sufficiently increase the amount of work one man can do, and do not ordinarily develop enough power for operating separators, etc. The 3-plow tractor was distinctly the favorite among farmers operating 150 or more crop acres.

Considering the cost of tractors, the bulletin points out, the price the farmer can pay depends on the amount and value of the work which the machine will perform annually, the value of horses displaced, value of man labor saved and the amount of increased returns which can reasonably be expected from its use. Prices paid in New York State in 1917 averaged $775 for the 2-plow and $1,050 for the 3-plow machines, while plow prices averaged $120 and $145 respectively.

The average length of life expected from tractors was reported by the farmers at 9 years, those whose machines had proved profitable estimating 9½ years, while those which had unprofitable investments gave an average of 5¾ years.

Farm tractors in New York are used on a daily average of 54 days annually, including both home and custom work. On farms of 100 acres or less (average 81) average days used on the home farm totaled 33, while on farms of 151 to 250 crop acres (average 193) the outfits were used on the home farm 47 days. The tractors owned by the smaller farms were used considerably more, it was found, for custom work than the larger farm outfits. While these figures appear low, says the bulletin, it must be remembered that on farms where horses do all the work they only average 100 days annually, and where both horses and tractors are used the machine need not be expected to have employment for as many days annually, and even if the machine were to do all the work formerly done by horses it would not be employed 100 days per year because it works more rapidly than horses.

Repairs are needed according to the efficiency of the operator and the care he gives the outfit when in use or idle, the conditions under which the outfit is used, the load it is required to pull and the quality of the machine itself. Many tractors are kept in repair by the makers during the first year and the owners therefore do not bear the full expenses until the second year.

Cost of Repairs

Of 86 tractor owners in New York who have used their outfits one season or less (average 9 months) 31 reported nothing spent for repairs. The others have repair bills varying from a few cents to $100, the average being $17, making the average repairs for the entire group about $11.

Comparatively few machines go through their second season without repair charges. The average repairs for 102 outfits averaging 18 months old was $34. For 30 machines averaging 30 months the average repairs amounted to $101. These machines were almost exclusively 2 and 3-plow outfits. The 3-plow outfits were the more costly, but the larger machines also average more days' use annually since they were on larger farms.

The figures given indicate annual repair charges during the first 3 years of about 4 per cent of the first cost, but this, says the bulletin, would undoubtedly increase in the latter years of its life.

According to the figures used by the tractor owners 2-plow outfits plowed 4½ acres per day (10 net working hours) and the 3-plow machines plowed 6¼ acres. Replies also showed that large gang plows will not cover as many acres per day as smaller ones when used under unfavorable plowing conditions.

Only 7 per cent of the tractor owners

in New York State reported doing hauling with their outfits—the small percentage being due to the restrictions against the use of tractors on New York highways.

The cost of operating a tractor, it is pointed out, is made up of operating expenses, including fuel oil and grease, repairs, depreciation and cost of man labor. In addition there are less important charges, such as interest on the investment and housing.

The New York farmers reported an average cost per acre plowed for gasoline, oil and grease of 99½ cents where gasoline is used and 49 cents where kerosene is used, with an allowance of 2 cents per acre for gasoline used in warming up.

About 3½ gallons of either gasoline or kerosene were consumed per acre in plowing for all tractors reported. Less difficulty was also reported by owners of kerosene tractors as compared with a few years ago. Seventy-five per cent of the tractor owners reported that they were operating on kerosene.

One Quart Oil Per Acre

The average quantity of oil per acre used in plowing was nearly one quart which, with oil at 40 cents per gallon, amounted to 10 cents per acre. Some reported using a gallon of lubricating oil per acre and others less than one quart per acre with the 3-plow machines slightly more economical than the 2-plow. Grease cost amounted to 2 cents per acre.

The average annual repair charges for the 2 and 3-plow outfits was 57½ cents and 78 cents per day respectively, making the repair charge per acre 12¾ and 12½ cents respectively.

The average annual depreciation on the 2 and 3-plow outfits amounted to $91.18 and $123.54 respectively. The depreciation cost per acre was 37½ cents for the 2-plow and 36¾ cents for the 3-plow.

Eighteen per cent of the tractor owners reported hired operators. Some entrusted their machines to ordinary hired hands at low wages and others secured first class operators at fairly high wages. The cost per acre for man labor with 2 and 3-plow outfits averaged 67 cents and 48 cents respectively, showing that the higher the wages paid the greater were the advantages derived from the larger tractors.

Estimating interest at 6 per cent on the average investment the average interest charged per day for the 2 and 3-plow outfits amounted to 43 and 58¼ cents respectively, or the average charged per acre amounted to 9½ and 4¼ cents respectively. The number of days a tractor is used annually, the bulletin reminds, the less the interest charge is per unit of work.

The approximate total cost for plowing an acre with a tractor under normal conditions is shown to be as follows:

Approximate cost of plowing an acre with 2 and 3-plow tractors, based on average cost of $775 and $1,050 respectively, and a life of 8½ years of 54 working days per year:

Size of tractor	Gasoline	Kerosene	Oil	Grease	Repairs	Depreciation	Man Labor	Interest
Two-plow	$0.87½	$0.37	$0.10	$0.02	$0.12¾	$0.37½	$0.67	$0.09½
Three-plow	0.87½	0.37	0.10	0.02	0.12½	0.36¾	0.48	0.09¼

Tractor Beats Horses

In discussing economy of the tractor 185 of the 217 owners, or 85 per cent, reported a saving in the amount of hired help. Fifty-seven reported of saving wages of $213 annually, the equivalent of one man for 71 days at $3 per day. Other savings which were overlooked in the reports were the use of the power for threshing, silo filling, shredding, etc.

More than 50 per cent of the tractor owners reported the quality of the work done by the tractor as better than that done by horses, while only 6 per cent said it was poorer. The quality of the work done, the bulletin points out, depends more on the plow and its adjustment than on the tractor. The average depth of plowing done by tractors in New York was over 7½ in., while the average depth previously plowed by horses was slightly less than 6½ in.

Many owners reported difficulty in securing capable tractor operators. Although no figures were made available the answers showed definitely that it paid to secure first class operators at higher wages.

Forty-eight per cent of the 217 owners reported that their outfits were not disabled a single day when needed during the past season, and of the remaining 52 per cent the average number of days their tractors were out of commission when needed was 6¼, not including four men, who stated that their machines were out of commission a large part of the time. About 82 per cent of the tractors were operated by the owner or some member of his family, best results usually being obtained by this class of operators. Twenty-eight per cent reported no time lost in the field on account of trouble and the average time lost per day by the 72 per cent reporting trouble was a little less than one hour.

That tractors do not entirely displace horses was shown by the fact that in two-thirds of the cases the tractor was used only on the same number of acres as was previously farmed, in these instances displacing horses on an average of about two and one-half.

Many tractor owners used their outfits for custom work, 42 per cent reporting custom work with the average number of days used annually for this purpose amounting to 24.

In summarizing, the bulletin states that the replies from the farmers do not indicate a considerable effect on the crop yields as a result of the use of tractors in the place of horses. It points out that it is obviously impossible to obtain maximum results with a tractor when it is used with implements designed for use with horses and that the plows used with it must be especially designed for the purpose.

—

Texas Has 4144 Tractors

FORT WORTH, Nov. 25—Although the lands of Texas, particularly the level prairie country of the western portion of the State, are specially adapted to the most economic and satisfactory use of the farm tractor in plowing and other farm work there are at this time only 4144 of these machines in use upon Texas farms, according to statistics just compiled by the Chamber of Commerce of Fort Worth. These figures show that there is an average of one tractor to every 30,000 acres of farm land and one tractor to every 102 farms. Sixty-seven Texas counties are without a single tractor and 100 counties have less than 10 each, while only 27 counties in the State have 50 or more tractors.

It is reliably estimated that Texas has only 5 per cent of the necessary number of farm tractors, and it is generally conceded that there is an immediate demand in this State for 50,000 of these machines. To purchase this number will require a minimum investment of $50,000,000.

—

Buyers Holding Off

BOSTON, Nov. 23—Sales in Boston showed a tendency to slump a bit following the declaration that the ban would be lifted on the production of motor cars. A number of the dealers report that prospective buyers are holding off because they look for a drop in prices in the spring or before that time. Even some of the sub-dealers are refusing now to take cars from distributers because they want to be protected against a drop in price, and this assurance the dealers cannot give. The fact that Cadillac has announced a $300 cut, and another is expected to make a similar announcement about Dec. 1, has led buyers and some dealers to expect this reduction will be general. Until a few of the other big dealers come out and state that present prices will hold good for some time there will be a fluctuation in sales, caused by the uncertainty.

—

Oil Exports from Mexico

NEW YORK, Nov. 25—Exports of crude oil from Tampico, Mexico, to the United States during September amounted to 4,038,167 bbl. Of this quantity 2,785,935 bbl. were from Tampico itself, 842,744 bbl. were from Tuxpam and 409,458 bbl. from the new loading station at Port Lobos.

—

Overseas Gasoline Demand Increases

WASHINGTON, Nov. 25—The overseas demand for the motor transport grade of gasoline has increased rather than diminished since the signing of the armistice, the Fuel Administration announced yesterday. This fact, as well as domestic requirements, will have a considerable bearing, the announcement said, on any decision whether it is desirable to fix a standard of quality for domestic motor gasoline, which now is under consideration.

Allison Leaves Chicago Packard

CHICAGO, Nov. 23—H. M. Allison, who has been in charge of Packard distribution in this territory twelve years, has resigned as president and general manager of the Packard Motor Car Co. of Chicago. Mr. Allison has been identified with Packard here and in Detroit for nearly fifteen years. For two years he was president of the Chicago Automobile Trade Association. Much of the credit for the establishment of the National Used Car Market Report by Chicago dealers is given to him. A member of the Packard executive staff at Detroit is expected to succeed Mr. Allison. No information as to Mr. Allison's own future plans is available just now.

—

W. C. Potter Resigns

WASHINGTON, Nov. 23—William C. Potter, Chief Assistant Director of Air Service under John D. Ryan, has resigned his position. Mr. Potter served as chief of the equipment division of the Signal Corps when that department controlled airplanes. With the reorganization he entered as the assistant to Mr. Ryan. Mr. Potter was associated with the Guggenheim mining interest as general manager of the American Smelting & Refining Co. prior to his connection with the Signal Corps, and will return to that work.

—

I. H. Mills, who has been associated with the Westinghouse Electric & Mfg. Co., East Pittsburgh, for the past 23 years, has resigned to become superintendent of the Sperry Gyroscope Co., Brooklyn, N. Y. Mr. Mills began his career with the Westinghouse as a machine operator, and finally became superintendent of the small industrial motor department.

—

Frank A. Sharpe has been made district manager for the Thermoid Rubber Co., Trenton, N. J., with offices located in the Kresge Building, Detroit.

—

Capt. Charles E. Speaks has been promoted Major in the Quartermaster Department. He is at present in France.

—

Saloniki Good Distributing Center

WASHINGTON, Nov. 25—Although Saloniki, Greece, has suffered considerably from the war and also from a huge fire in 1917 and trade conditions temporarily are unfavorable, the American Consul General there reports that its future as a distributing center is a positive one, and manufacturers will find it worth consideration as a distributing point for trade with Serbia, Bulgaria and Rumania. It is now proposed to have a free customs zone at those ports which will further increase its distributing value. The Standard Oil Co. has a huge floating pipe line system at Saloniki and carries great stocks of petroleum and petroleum products at this point.

Men of the Industry

Changes in Personnel and Position

McLaughlin a G.-M. Director

TORONTO, Nov. 25—R. S. McLaughlin, of Oshawa, Ont., president of the McLaughlin Motor Car Co., Limited, has been elected a director and member of the executive committee of the General Motors Corp.

—

Adams Heads Peterson-Culp

DENVER, Nov. 26—J. P. Adams was re-elected president of the Peterson-Culp Gearless Steam Auto Co. at the annual meeting of the company recently. L. Leitner, formerly consulting engineer, was elected secretary and treasurer. The company proposes to build a factory in Denver and to produce both passenger cars and trucks.

—

Highways War Service Committee

WASHINGTON, Nov. 26—The Highway Industries Association has formed a War Service and Reconstruction Committee of the Highway Industries with the co-operation of the Chamber of Commerce of the United States.

This new War Service and Reconstruction Committee will take part in the general conference of War Service and Reconstruction Committees of American Industry, to be held at Atlantic City, N. J., beginning Dec. 3, under the auspices of the National Chamber, the week preceding the great highway convention in Chicago.

Representing the Highway Industries Association: W. T. White, Cleveland; A. N. Johnson, Chicago; W. P. Blair, Cleveland; A. P. Sandles, Columbus; A. R. Hirst, Madison, Wis.; E. J. Mehren, New York; S. T. Henry, Washington; H. G. Shirley, Washington.

Representing the American Association of State Highway Officials: Lieut.-Col. W. D. Uhler, Washington; G. P. Coleman, Richmond; W. G. Thompson, Trenton; J. N. Mackall, Baltimore; C. F. Stern, Sacramento; P. D. Sargent, Augusta; W. S. Keller, Birmingham; Ira L. Browning, Salt Lake City; E. A. Duffey, Albany; Max L. Cunningham, Oklahoma City.

Representing the American Automobile Association: David Jameson, president, New Castle, Pa.; A. E. Batchelder, executive chairman, Washington; Carl J. Fisher, chairman Touring Board, Indianapolis; Geo. C. Deihl, chairman Good Roads Board, Buffalo; Eugene Burton, chairman Legislative Committee, Newark.

Representing Highway Transport Committee: Roy D. Chapin, chairman Highway Transport Committee, Washington.

Representing the Office of Public Roads, L. W. Page, director Office of Public Roads, Washington, D. C.

Gilmore Heads Packard Branch

NEW YORK, Nov. 25—Roger J. Gilmore has been elected president of the Packard Motor Car Co. of New York. Gilmore, who has been vice-president of the company, has been in charge of its affairs since former President Hare was made executive vice-president of the parent company.

—

Jamieson in Charge of Equipment Disposition

WASHINGTON, Nov. 23—Disposition of all manufacturing materials, equipment and buildings which will now or later become the property of the United States as a result of contract cancellations by the Ordnance Department will be in charge of a board headed by Brig.-Gen. C. C. Jamieson, which will decide their sale or storage.

—

F. E. Pierce, formerly advertising manager of the Anderson Electric Car Co., Detroit, has been appointed district manager for the Elwell-Parker Electric Co., manufacturer of industrial trucks and tractors, with headquarters in Detroit, and with factories in both Detroit and Cleveland.

—

L. C. Reynolds, formerly associated with the Oakland Motor Car Co., Pontiac, Mich., has been appointed manager of the motor factory of the General Motors Co. in Detroit.

—

H. W. Simpson, formerly inspector of aviation engines, Signal Corps, Detroit, has been appointed assistant engineer with Henry Ford & Son, Dearborn, Mich.

—

H. L. Dunn, assistant purchasing agent of the Willys-Overland Co., Toledo, has been transferred to Moline, Ill., where he will become identified with the Moline Tractor Co., recently acquired by John N. Willys.

—

Propose Southern Air Mail Route

WASHINGTON, Nov. 25—The Birmingham, Alabama, Chamber of Commerce has requested Congress to place Birmingham on an air mail route between the Atlantic and Pacific Coasts. An aerial route is proposed to start at New York and go through Philadelphia, Baltimore, Washington, Virginia, the Carolinas, Charlotte and Atlanta, Ga., Birmingham, Ala., Vicksburg, Miss., Shreveport, La., Dallas, Fort Worth, Tex., Arizona and New Mexico and then to San Diego. There is already an aviation field constructed according to Government specifications at Birmingham. Senator Miles Poindexter will ask Congress for an appropriation to inaugurate this route and two others which will traverse the central and northern portions of the country.

—

N. A. A. J. Directors to Meet

NEW YORK, Nov. 26—Directors of the National Association of Automobile Accessory Jobbers are to meet at the La Salle, Chicago, Nov. 16 and 17.

Canadian Plant for Denby

CHATHAM, ONT., Nov. 25—At a special meeting of the Chatham City Council an agreement was signed between the city and the Denby Motor Truck Co. calling for the erection of a $20,000 plant here, to be ready for occupancy by March 1. The company is newly incorporated in Canada, with a capital stock of $200,000. The city will vote on giving the company three acres of land now, and an additional acreage will be made available if the company needs it within 4 years. The plant of the Chatham Brass Works here has been purchased by the Denby company, which plans to use it for the manufacture of axles and transmissions.

—

Recall Aero Training Squadrons

WASHINGTON, Nov. 26—Thirty-one aero squadrons training in England have been recalled to this country and sailed from Liverpool Nov. 22. They included 5,000 enlisted men and 110 officers, besides a complete Handley-Page training section of 126 officers and 449 enlisted men.

—

Federal Tax on Cars Dropped

WASHINGTON, Nov. 26—The Senate Finance Committee today entirely struck out the proposed federal license tax on the use of automobiles and motorcycles which ranges from $10 to $50 annually, according to horsepower, in the House Bill, and from $5 to $25 under the plan previously adopted by the Senate Committee. The National Automobile Chamber of Commerce plans to ask that the tax against parts sold by truck and passenger car makers also be stricken from the bill. It is believed that this tax is eventually and actually upon the consumer, the user of a passenger car or truck.

—

Contracts for 300 Hydroplanes Cancelled

WASHINGTON, Nov. 26—Contracts for 300 hydroplanes have been cancelled by the Navy Department since the signing of the armistice. The Navy aviation appropriations for 1920 will be reduced as a result by $133,770,700. These figures were presented to the House Naval Committee by Rear Admiral Peoples yesterday.

—

Quartermaster Contracts

WASHINGTON, Nov. 25—The following contracts, placed prior to the armistice, have just been announced by the Quartermaster Department:

Timken-Detroit Axle Co., Detroit, axles, $6,391.
The Studebaker Corp. of America, South Bend, wagons, $6,406.56.
B. F. Goodrich Co., Akron, tires, $19 041.50.
The Atlantic Refining Co., Philadelphia, fuel oil, $7,753.20.

—

Tank Plant for Tractors

DETROIT, Nov. 25—Work will be pushed rapidly on the uncompleted plant which Henry Ford has been building at Dearborn for the manufacture of small tanks.

Current News of Factories

Notes of New Plants—Old Ones Enlarged

Substitute for Gasoline Tested

(*Continued from page* 933)

The type B fuel at full throttle resulted as follows:

	R.P.M.	Beam, Lb.	B.H.P.	Consumption
Gasoline	523	125.5	21.9	0.13
"B" fuel	529	129.5	22.8	0.115

The airplane engine tests using 150 hp. Hispano-Suiza engine resulted as follows:

R.P.M.	Lb. Torque	Oil Inlet Fahr.	Water Inlet Fahr.	Air Intake Fahr.	Lb. Fuel
		Liberty Fuel			
1583	335.0	154°	154°	91.4°	5
1388	326.0	158°	145°	87.8°	10
1194	332.5	148°	141°	86.0°	5
		Export Airplane Gasoline			
1588	326.5	145°	162.5°	89.6°	5
1390	324.7	152°	161.0°	87.8°	10
1188	321.0	149°	158.0°	86.0°	5
		Export Airplane Gasoline			
1600	330.0	125.6°	158.0°	85.0°	5
1400	326.0	134.0°	154.0°	89.0°	10
1200	322.0	141.0°	157.0°	85.0°	5
		Liberty Fuel			
1600	340.0	146.0°	161.0°	89.0°	5
1400	340.0	152.0°	161.0°	87.0°	10
1200	332.0	146.0°	163.0°	86.0°	5

Following is the analysis made by the Bureau of Standards of the Liberty fuel submitted under Laboratory Tests Nos. 49,082 and 24,439:

Distillation, Per Cent	Fahr.
10	174.2°
20	176.0°
30	177.8°
40	179.6°
50	179.6°
60	181.4°
70	183.2°
80	194.0°
90	342.5°
95	388.4°
97 (dry point)	405.0°

Following are reports made on two other samples of Liberty fuel which were tested by the Bureau of Standards on Sept. 10, test numbers being 45,962-3 and 24,135:

Fuel	G	F
Appearance	Clear White	Clear White
Odor	Normal	Normal
Specific Gravity at 60° Fahr.	.751	.730
Distillation	Fahr.	Fahr.
10	183.0°	161.0°
20	219.2°	183.2°
30	235.4°	203.0°
40	257.0°	221.0°
50	273.2°	237.2°
60	305.6°	249.8°
70	320.0°	262.4°
80	340.0°	280.4°
90	363.2°	309.2°
95	401.0°	341.6°
97 (dry point)	425.0°	——
95.5 " "	——	360.0°
Residue	1.5%	1.2%
Loss	1.5%	1.3%

The future of this gasoline substitute is as yet undecided—that is, it is not known at this time just how the formula will be given out or sold or in what way it will be commercialized.

Wright-Martin Working Three Shifts

NEW YORK, Nov. 21—Up to the present time the Wright-Martin Aircraft Corp., New Brunswick, has not received any cancellations of Government orders. The company is operating three shifts as usual and is producing nothing but Hispano-Suiza engines. Production is to be at a scheduled rate and will continue practically until the end of 1919. The only change which has been made in schedules has been the elimination of overtime work.

—

Another G.-M. Canadian Plant

WINDSOR, ONT., Nov. 25—A site has been purchased and building may start shortly for a motor truck factory costing $50,000 for the General Motors Corp., Detroit.

—

Franklin Reduces Prices

SYRACUSE, Nov. 26—The Franklin Automobile Co. has reduced its passenger car prices. New and former prices follow:

Model	New Price	Old Price
2-Passenger	$2,400	$2,850
4-Passenger	2,450	2,900
5-Passenger	2,450	2,900
Sedan	3,350	3,900
Limousine	3,400	4,000
Brougham	3,300	3,850

—

Probable Effects of War Motor Apparatus on Commercial Design

(*Continued from page* 906)

axles and lanterns. This car is also mounted on 36 x 6 pneumatics, the standard equipment being Goodyear cords with all-leather tread.

These are only random examples of a line of over a hundred different types of vehicles which have been adapted by the Motor Equipment Section for military use. The result has been the gathering together of as fine a collection of specialized designs as has ever been assembled.

It is not permissible even now, with the armistice in force, to go into full details on many of the products of the Motor Equipment Section, but it can be stated that in addition to the transportation and hauling equipment a great number of vehicles for offensive purposes have been developed.

The vast personnel required to perfect these vehicles will soon be released in large part from war service. The industry can utilize these men with wonderful results because they have been used to rapid and efficient work and they have gained experience in laying out highly useful designs adapted to give maximum service. Many of the ideas generated in the War Department offices can be taken bodily for commercial practice, while others are adaptable. It will be an important feature of our reconstruction work to utilize as much of the knowledge gained in war work as possible.

Port Huron Friction Drive Tractor

(*Continued from page* 928)

neto of the high-tension type, with impulse starter, is fitted. Cooling is accomplished by forced circulation, through a Perfex radiator.

The fuel capacity is 25 gal. of kerosene and 5 gal. of gasoline, and the fuel goes to the motor through a Kingston single-bowl carbureter fitted with a Bennett air cleaner.

The steering gear is of the screw and nut type and the tractor has a turning radius of 6 ft. inside of the inner wheels.

The frame of the tractor is made of steel channels. The front axle is of the built-up type and carries a coil spring upon which the front end of the frame rests. The tread of the front wheels is 52 in. and of the rear wheels 56 in. The front wheels are 34 in. in diameter with 6-in. face, and the rear wheels 56 in. in diameter with 10-in. face.

The over-all length of the tractor is 13 ft.; total width, 6 ft. 3 in.; total height, including canopy top, 8 ft. 9 in., and the wheelbase, 7 ft. 9 in. Without fuel and wheel lugs, but with canopy top, the tractor weighs 5700 lb.

The speed of the tractor is variable from 1⅞ to 4 miles per hour, in either direction, and it is recommended for use with three 14-in. plows. The belt speeds are variable from 2380 to 3900 ft. per minute.

—

Four Hispano-Suiza Models Built in America

(*Continued from page* 915)

cylinder block, a relief valve being placed in the line to prevent the pressure at the carbureter becoming greater than 2 lb. This valve can be adjusted in accordance with the varying altitudes at which the machine travels. Sufficient pressure for starting is obtained by using a hand pump. If desired, a vacuum tank system may be used, the vacuum being usually secured by taking a lead from the throat of a compound venturi, placed in the draft of the propeller, to the main gasoline tank, a check valve being placed in the line and a branch line leading to the auxiliary fuel tank.

A centrifugal pump with two discharge outlets, which is mounted directly underneath the oil pump, circulates the cooling water through the waterjackets of the two cylinder blocks. The water pump is driven from the same shaft as the oil pump at 1.2 times engine speed. Its capacity is 100 litres (26.50 gal.) per minute at an engine speed of 1450 r.p.m. The cylinder waterjackets have a capacity of 18½ litres (4.9 gal.), or, by weight, 18½ kg. (41 lb.).

An interrupter driving mechanism is used to fire a machine gun which is synchronized with the propeller. This mechanism is operated by a gear pinned to the lower gear on the lower half of the vertical shaft which drives the camshaft of either the left or right hand cylinder block. Two ball bearings carry the interrupter shaft, which is driven at crankshaft speed. It is bolted by a double flange connection to the driving shaft, one shaft having one less bolt hole than the other. When the firing mechanism is properly set, a bullet fired from the gun will miss the trailing edge of the propeller by ½ inch.

When fitting the Hispano-Suiza engine to a plane, it is anchored on a rigid support, lined at the points of contact with fiber or sheet metal, the engine base being set flat on the support members. To facilitate disassembly, the camshaft and valve gear housings are usually left exposed, enabling the plane constructor to use smaller cowls. When an engine is mounted without cowls, it is necessary to protect the magnetos by covers, usually of leather.

To carry away any gasoline that may overflow from the bowl of the carbureter or drip back during maneuvers in the air a small drain pipe is attached to a nipple at the bottom of the carbureter. The excess gasoline is discharged as far as possible to the rear under the planes and away from the exhaust lines.

—

Contracts Placed

WASHINGTON, Nov. 23—Following is a list of contracts placed by the Bureau of Aircraft Production prior to the armistice and just announced:

Nov. 1

Ideal Clamp Mfg. Co., 25,000 hose clamps, 385.
Champion Spark Plug Co., 12 spark plug cleaners, $4.20.

Calendar

ENGINEERING

S. A. E. Meetings

1919

Jan. 8—Minneapolis Section, S. A. E.—Hotel Radisson. "Governors for Tractors and Truck Engines."
Jan. 12, 13, 14—New York—Winter Meeting, Society of Automotive Engineers, Engineering Societies' Building.
Feb. 5—Minneapolis Section, S. A. E.—Hotel Radisson. "Radiator Cooling Fans."
Mar. 5—Minneapolis Section, S. A. E.—Hotel Radisson. "Tractor Service and Sales."
Apr. 2—Minneapolis Section, S. A. E.—Hotel Radisson. "Implements Designed for Tractor Belt Power and Their Characteristics."

CONVENTIONS

Dec. 4-5-6—Atlantic City—War Emergency and Reconstruction Conference of War Service Committees.
Dec. 9—Philadelphia, Pa.—Meeting, Philadelphia Automobile Trade Assn.
Dec. 9-13—Chicago—Convention Highway Industries Association, Congress Hotel.
Dec. 11—New York—Annual Dinner Portland Cement Association, Biltmore Hotel.

1919

Feb. 17-22—Des Moines, Ia.—Tenth Annual Automobile Show, Des Moines Automobile Dealers' Assn.
Feb. 25-28—New York—American Road Builders' Assn., Sixteenth Annual Convention.

SHOWS

1919

Jan. 13-19—Des Moines, Ia.—First Tractor Show. Des Moines Thresher & Tractor Club. H. J. Clark, Mgr.
Feb. 17-22—So. Bethlehem, Pa.—Passenger Car Show. Lehigh Valley Auto Shows Co. J. L. Elliott, Mgr.
Feb. 24-27—So. Bethlehem, Pa.—Motor Truck Show. J. L. Elliott, Mgr.

A New British Coke-Fired Steam Commercial Vehicle

(*Continued from page* 921)

returns the water of condensation to the tank through a filter in which the cylinder oil is extracted.

It will be noted from the foregoing description and accompanying drawings that the new Clarkson chassis is identical with a gasoline 3-ton model in all respects with the exception of the power unit, i.e., the frame, axles, gearbox and clutch of a 3-ton gasoline chassis could be fitted with either a gasoline motor or a Clarkson coke motor.

The increasing cost and scarcity in Great Britain of all liquid fuels, including gasoline, benzol, kerosene and alcohol, made it imperative to develop to the utmost extent the use of solid fuels. Of the solid fuels available coke is by far the most abundant as well as the cheapest form in which thermal units can be purchased. The consumption is about 5 lb. p.m. when loaded and 3.5 lb. when light, and it is calculated that at present prices in Great Britain the fuel cost per mile is approximately one-fourth as much with coke as with gasoline.

Curtiss Aeroplane & Motor Corp., 50 gasoline shutoffs, $72.50.
McCord Mfg. Co., 648 spark plug gaskets, $2.92.
Curtiss Aeroplane & Motor Corp., 16 V-2-3 engine No. 31580 propeller hubs, $369.60.
Vichek Tool Co., Liberty engine spark plug wrenches, $19.68.
Wright-Martin Aircraft Corp., 80 sets tools for Hispano-Suiza motors, $15,744.
S. F. Bowswer & Co., 180-gal. gasoline truck, tank and pump, $274.50.
Wright-Martin Aircraft Corp., parts for Hispano-Sulza engine, $2,983.39.
Wright-Martin Aircraft Corp., tools for Hispano-Suiza motors, $43.94.
Wright-Martin Aircraft Corp., parts Hispano-Sulza engines, $7.49.
Curtiss Aeroplane & Motor Corp., 25 tail-skid braces, $107.25.

Nov. 2, 1918

Curtiss Aeroplane & Motor Corp., 85 pro skids, wing, rathan, aeroplane, $238.
Wright-Martin Aircraft Corp., 35 No. 9968 magneto couplings, $40.95.
Standard Stamping Co., gasoline cans, $40.
The Vichek Tool Co., 6 cotter-pin, $0.30.
Oxweld Acetylene Co., Davis-Bournonville Co., welding material, $164.45 and $38.
Armstrong Bros. Tool Co., wrenches, $14.38.

Nov. 4, 1918

Standard Turnbuckle Co., 1000 turnbuckles for JN4 planes, $600.
Eastern Machine Screw Corp., 7000 bolts for JN4 planes, $515.10.
Thomas Morse Aircraft Corp., 15 sets controls for S4C planes, $2.295.
Thomas Morse Aircraft Corp., 38 axles for S4C planes, $646.
Wright-Martin Aircraft Corp., 25 exhaust valves for Hispano-Suiza 150-hp. engine, $162.75.
Splitdorf Electrical Co., spares for Hispano-Suiza "A" engines, $87.23.
Wright-Martin Aircraft Corp., running magneto assembly, $80.
Metal Specialties Mfg. Co., 975 instrument, 13,000 lights and bulbs for DH4 planes, $4.333.88.
Wright-Martin Aircraft Corp., Hispano-Suiza "A" 150-hp. engine repairs, $10,573.26.
Hartzell Walnut Propeller Co., 4 propellers for 300-hp. Hispano-Suiza, $500.

Nov. 5, 1918

A. Schrader's Son (Inc.), 1250 tire valves (inside), $32.
Harrison Radiator Corp., 8 JN6H radiators, $440.
The American Metal Hose Co., 750 rubber connections and 750 ferrules for oxygen tubing, $42.19.
Curtiss Aeroplane and Motor Co., spare parts for JN4 planes, $927.50.
Willys-Overland Co., crankshaft assembly balanced, OX-5, 1986, No. 41754, $287,970.